



## **DEPARTMENT OF THE INTERIOR**

### **Fish and Wildlife Service**

#### **50 CFR Part 17**

**[Docket No. FWS–R4–ES–2016–0090;4500030113]**

**RIN 1018–BB48**

**Endangered and Threatened Wildlife and Plants; Proposed Threatened Species Status for *Sideroxylon reclinatum* ssp. *austrofloridense* (Everglades Bully), *Digitaria pauciflora* (Florida Pineland Crabgrass), and *Chamaesyce deltoidea* ssp. *pinetorum* (Pineland Sandmat) and Endangered Species Status for *Dalea carthagenensis* var. *floridana* (Florida Prairie-Clover)**

**AGENCY:** Fish and Wildlife Service, Interior.

**ACTION:** Proposed rule.

**SUMMARY:** We, the U.S. Fish and Wildlife Service (Service), propose threatened species

status under the Endangered Species Act of 1973 (Act), as amended, for *Sideroxylon reclinatum* ssp. *austrofloridense* (Everglades bully), *Digitaria pauciflora* (Florida pineland crabgrass) and *Chamaesyce deltoidea* ssp. *pinetorum* (pineland sandmat), and endangered species status for *Dalea carthagenensis* var. *floridana* (Florida prairie-clover). All four plants are from south Florida. If we finalize this rule as proposed, it would extend the Act's protections to these plants. The effect of this regulation will be to add these species to the List of Endangered and Threatened Plants.

**DATES:** We will accept comments received or postmarked on or before [**INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER**]. Comments submitted electronically using the Federal eRulemaking Portal (see **ADDRESSES** below) must be received by 11:59 p.m. Eastern Time on the closing date. We must receive requests for public hearings, in writing, at the address shown in **FOR FURTHER INFORMATION CONTACT** by [**INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER**].

**ADDRESSES:** You may submit comments by one of the following methods:

(1) *Electronically:* Go to the Federal eRulemaking Portal:

<http://www.regulations.gov>. In the Search box, enter FWS–R4–ES–2016–0090, which is the docket number for this rulemaking. Then, in the Search panel on the left side of the screen, under the Document Type heading, click on the Proposed Rules link to locate this document. You may submit a comment by clicking on “Comment Now!”

(2) *By hard copy:* Submit by U.S. mail or hand-delivery to: Public Comments Processing, Attn: FWS-R4-ES-2016-0090; U.S. Fish and Wildlife Service Headquarters, MS: BPHC, 5275 Leesburg Pike, Falls Church, VA 22041-3803.

We request that you send comments only by the methods described above. We will post all comments on <http://www.regulations.gov>. This generally means that we will post any personal information you provide us (see *Public Comments* below for more information).

**FOR FURTHER INFORMATION CONTACT:** Roxanna Hinzman, Field Supervisor, U.S. Fish and Wildlife Service, South Florida Ecological Services Office, 1339 20th Street, Vero Beach, FL 32960, by telephone 772-562-3909, or by facsimile 772-562-4288. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800-877-8339.

## **SUPPLEMENTARY INFORMATION:**

### **Executive Summary**

*Why we need to publish a rule.* Under the Act, if we determine that a species is an endangered or threatened species throughout all or a significant portion of its range, we are required to promptly publish a proposal in the **Federal Register** and make a determination on our proposal within 1 year. Listing a species as an endangered or threatened species and designations and revisions of critical habitat can only be completed by issuing a rule.

*What this proposed rule does.* This document proposes the listing of the *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* as threatened species, and *Dalea carthagenensis* var. *floridana* as an endangered species. The

four plants are currently candidate species for which we have on file sufficient information on biological vulnerability and threats to support preparation of a listing proposal, but for which development of a listing regulation has until now been precluded by other higher priority listing activities. This proposed rule reassesses all available information regarding status of and threats to the four plants.

*The basis for our action.* Under the Act, we may determine that a species is an endangered or threatened species based on any of five factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. We have determined that the threats to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* consist primarily of habitat loss and modification through urban and agricultural development, and lack of adequate fire management (Factor A) and proliferation of nonnative invasive plants, stochastic events (hurricanes and storm surge), maintenance practices used on roadsides and disturbed sites, and sea level rise (SLR) (Factor E).

*We will seek peer review.* We will seek comments from independent specialists to ensure that our proposed designation is based on scientifically sound data, assumptions, and analyses. We will invite these peer reviewers to comment on our listing proposal.

## **Information Requested**

### *Public Comments*

We intend that any final action resulting from this proposed rule will be based on the best scientific and commercial data available and be as accurate and as effective as possible.

Therefore, we request comments or information from the public, other concerned governmental agencies, Native American tribes, the scientific community, industry, or any other interested parties concerning this proposed rule. We particularly seek comments concerning:

(1) The four plants' biology, range, and population trends, including:

(a) Biological or ecological requirements of these plants, including habitat requirements for establishment, growth, and reproduction;

(b) Genetics and taxonomy;

(c) Historical and current range including distribution patterns;

(d) Historical and current population levels, and current and projected trends; and

(e) Past and ongoing conservation measures for the plants, their habitat, or both.

(2) Factors that may affect the continued existence of these plants, which may include habitat modification or destruction, overutilization, disease, predation, the inadequacy of existing regulatory mechanisms, or other natural or manmade factors.

(3) Biological, commercial trade, or other relevant data concerning any threats (or lack thereof) to these plants and existing regulations that may be addressing those threats.

(4) Current or planned activities in the areas occupied by these plants and potential effects (positive or negative) of these activities on these plants.

(5) Additional information concerning the biological or ecological requirements of these plants, including pollination and pollinators.

(6) Additional information concerning the current and projected effects of climate change, including sea level rise, on these plants and their habitat.

(7) Scientific information or analysis informing whether these plants more closely meet the definition of an endangered species or of a threatened species under the Act.

Please include sufficient information with your submission (such as scientific journal articles or other publications) to allow us to verify any scientific or commercial information you include.

Please note that submissions merely stating support for or opposition to the action under consideration without providing supporting information, although noted, will not be considered in making a determination, as section 4(b)(1)(A) of the Act directs that determinations as to whether any species is a threatened or endangered species must be made “solely on the basis of the best scientific and commercial data available.”

You may submit your comments and materials concerning this proposed rule by one of the methods listed in **ADDRESSES**. We request that you send comments **only** by the methods described in **ADDRESSES**.

If you submit information via <http://www.regulations.gov>, your entire submission—including any personal identifying information—will be posted on the website. If your submission is made via a hardcopy that includes personal identifying information, you may request at the top of your document that we withhold this information from public review. However, we cannot guarantee that we will be able to do so. We will post all hardcopy submissions on <http://www.regulations.gov>.

Comments and materials we receive, as well as supporting documentation we used in preparing this proposed rule, will be available for public inspection on <http://www.regulations.gov>, or by appointment, during normal business hours, at the U.S. Fish

and Wildlife Service, South Florida Ecological Services Office (see **FOR FURTHER INFORMATION CONTACT**).

#### *Public Hearing*

Section 4(b)(5) of the Act provides for one or more public hearings on this proposal, if requested. Requests for public hearings must be received within 45 days after the date of publication of this proposed rule in the **Federal Register** (see **DATES**). Such requests must be sent to the address shown in **FOR FURTHER INFORMATION CONTACT**. We will schedule public hearings on this proposal, if any are requested, and announce the dates, times, and places of those hearings, as well as how to obtain reasonable accommodations, in the **Federal Register** and local newspapers at least 15 days before the hearing.

#### *Peer Review*

In accordance with our joint policy on peer review published in the **Federal Register** on July 1, 1994 (59 FR 34270), we will seek the expert opinions of at least three appropriate and independent specialists regarding this proposed rule. The purpose of peer review is to ensure that our listing determination and critical habitat designation are based on scientifically sound data, assumptions, and analyses. The peer reviewers will have expertise in the biology, habitat, and conservation status of these plants, to help inform our determination.

#### **Previous Federal Actions**

*Digitaria pauciflora* was first recognized as a candidate species on September 27, 1985 (50 FR 39526). The 1990 Candidate Notice of Review (CNOR) published in the **Federal Register** on February 21, 1990 (55 FR 6184), included *Digitaria pauciflora* as a candidate for

listing under the Act. We determined at that time that listing was warranted, but precluded due to workloads and competing priorities.

*Digitaria pauciflora* remained on the candidate list as published in the CNOR in 1993 (58 FR 51144, September 30, 1993). The CNOR was not published again until October 25, 1999, and it retained *Digitaria pauciflora* as a candidate and assigned a listing priority number (LPN) of 6; the 1999 CNOR first recognized *Chamaesyce deltoidea* ssp. *pinetorum* as a candidate and assigned an LPN of 12 and *Dalea carthagenensis* var. *floridana* as a candidate and assigned an LPN of 3 (64 FR 57534). Candidate species are assigned LPNs based on immediacy and magnitude of threats, as well as taxonomic status. The lower the LPN, the higher priority that species is for us to determine appropriate action using our available resources.

*Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* remained on the candidate list from 2001 to 2004 (66 FR 54808, October 30, 2001; 67 FR 40657, June 13, 2002; 69 FR 24876, May 4, 2004). *Sideroxylon reclinatum* ssp. *austrofloridense* was first recognized May 4, 2004, and was assigned an LPN of 12 (69 FR 24876, May 4, 2004). We published a finding for *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* in the 2005 CNOR on May 11, 2005 (70 FR 24870), in response to a petition received on May 11, 2004.

All four species remained candidates from 2005 to 2015 (70 FR 24870, May 11, 2005; 71 FR 53756, September 12, 2006; 73 FR 75176, December 10, 2008; 74 FR 57804, November 9, 2009; 75 FR 69222, November 10, 2010; 76 FR 66370, October 26, 2011; 77 FR 69994, November 21, 2012; 78 FR 70104, November 22, 2013; 79 FR 72450, December 5, 2014; 80 FR 80584, December 24, 2015).



On September 9, 2011, the Service entered into two settlement agreements regarding species on the candidate list at that time (Endangered Species Act Section 4 Deadline Litigation, No. 10–377 (EGS), MDL Docket No. 2165 (D.D.C. May 10, 2011)). This proposed listing rule fulfills the requirements of those settlement agreements for the 4 plant species.

## **Background**

It is our intent to discuss below only those topics directly relevant to the listing of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* as threatened species and *Dalea carthagenensis* var. *floridana* as an endangered species in this proposed rule.

*Sideroxylon reclinatum* ssp. *austrofloridense* (Everglades bully)

### **Species Description**

Corogin and Judd (2014, pp. 410–412) provide a detailed description of *Sideroxylon reclinatum* ssp. *austrofloridense*. The plant is a single- to many-stemmed shrub, 3–6 feet (ft) (1–2 meters (m)) tall. The branches are smooth, slightly bent, and somewhat spiny. The leaves are thin, oval-shaped, 0.8–2 inches (in) (2–5 centimeters (cm)) long, evergreen, lance-shaped, and fuzzy on their undersides. The flowers are in axillary cymes (Long and Lakela 1971, p. 679).

*Sideroxylon reclinatum* ssp. *austrofloridense* is distinguished from the similar subspecies *S. reclinatum* ssp. *reclinatum* in Florida by its leaves, which are persistently pubescent (fuzzy) on their undersides, rather than smooth or pubescent only along the leaf midvein (Wunderlin and Hansen 2003, p. 603). Corogin and Judd (2014, p. 404) indicated the two subspecies are most reliably distinguished by differences in the micromorphology of

the leaf epidermis, and by the extent of distribution of *S. r. ssp. austrofloridense*, which is limited to extreme southern peninsular Florida.

## Taxonomy

The genus *Sideroxylon* is represented by eight species in Florida. All of these species were previously assigned to the genus *Bumelia*. *Sideroxylon reclinatum*, the Florida bully, is represented by three subspecies that range nearly throughout Florida and into neighboring States. The Everglades subspecies was first recognized by Whetstone (1985, pp. 544–547) as *Bumelia reclinata* var. *austrofloridense*, then transferred to the genus *Sideroxylon* (Kartesz and Gandhi 1990, pp. 421–427). Kartesz and Gandhi (1990, pp. 421–427) made *Sideroxylon reclinatum* ssp. *austrofloridense* a subspecies rather than a variety; however, in plant nomenclature, the ranks of variety and subspecies are interchangeable. *Sideroxylon reclinatum* ssp. *austrofloridense* is used in the current treatment of the Florida flora (Wunderlin and Hansen 2016, p. 1).

The Integrated Taxonomic Information System (2016, p. 1) indicates that the taxonomic standing for *Sideroxylon reclinatum* ssp. *austrofloridense* (Whetstone) Kartesz and Gandhi is accepted. The online Atlas of Florida Vascular Plants (Wunderlin and Hansen 2016, p. 1) uses the name *S. reclinatum* ssp. *austrofloridense* (Whetstone), as does NatureServe (2016, p. 1).

Corogin and Judd (2014, p. 408) indicate that *Sideroxylon reclinatum* subsp. *austrofloridense* is differentiated from *S. reclinatum* subsp. *reclinatum* by a set of distinct characters at the micromorphological level.

The two taxa are also separated eco-geographically. *Sideroxylon reclinatum* subsp. *austrofloridense* is a narrow endemic, restricted to pine rockland and marl prairie habitats in a well-defined area of extreme southeastern peninsular Florida. Conversely, *Sideroxylon*

*reclinatum* subsp. *reclinatum* is more wide-ranging, occurring coastally from southern Georgia west to Louisiana, and throughout Florida as far south as Broward County in the east, and Collier and Monroe Counties in the west. The only place where plants of both species overlap is within Big Cypress National Preserve (BCNP), at the western fringe of Everglades bully's range (Corrogin and Judd 2014, p. 409).

## Climate

The climate of south Florida where *Sideroxylon reclinatum* ssp. *austrofloridense* occurs is classified as tropical savanna and is characterized by distinct wet and dry seasons and a monthly mean temperature above 18 degrees Celsius (°C) (64.4 degrees Fahrenheit (°F)) in every month of the year (Gabler *et al.* 1994, p. 211). Freezes can occur in the winter months, but are infrequent. Rainfall in the area where *Sideroxylon reclinatum* ssp. *austrofloridense* occurs varies from an annual average of 153–165 cm (60–65 in) in the northern portion of the Miami Rock Ridge to an average of 140–153 cm (55–60 in) in the southern portion. Approximately 75 percent of yearly rainfall occurs during the wet season from June through September (Snyder *et al.* 1990, p. 238).

## Habitat

*Sideroxylon reclinatum* ssp. *austrofloridense* grows in pine rockland habitat, marl prairie habitat, and within the ecotone between both habitats (Gann *et al.* 2006, p. 12; Bradley *et al.* 2013, p. 4, Gann 2015, p. 31). These habitats are maintained by regular fire, and are prone, particularly marl prairie, to annual flooding for several months during the wet season (Gann *et al.* 2006, p. 13; Bradley *et al.* 2013, p. 4). *Sideroxylon reclinatum* ssp. *austrofloridense* also

grows on the sunny edges of rockland hammock habitat (Gann 2015, p. 412), which is fire-resistant. Historically, fire served to maintain the boundary between pine rockland and rockland hammock by eliminating the encroachment of hardwoods into pine rocklands. Absent natural or prescribed fire, many pine rocklands have succeeded to rockland hammock (FNAI 2010, p. 25). Canopy cover on the interior of rockland hammock is too dense to support herbs and smaller shrub species, such as *S. r. ssp. austrofloridense*, that require more sunlight.

#### *Pine Rockland*

Pine rockland is characterized by an open canopy of South Florida slash pine (*Pinus elliotii* var. *densa*) with a patchy understory of tropical and temperate shrubs and palms and a rich herbaceous layer of mostly perennial species including numerous species endemic to South Florida. Outcrops of weathered oolitic (small rounded particles or grains) limestone, known locally as pinnacle rock, are common, and solution holes may be present. This subtropical, pyrogenic flatland can be mesic or xeric depending on landscape position and associated natural communities (Florida Natural Areas Inventory (FNAI) 2010, p. 61).

Pine rockland has an open canopy of South Florida slash pine, generally with multiple age classes. The diverse, open shrub and subcanopy layer is composed of more than 100 species of palms and hardwoods, most derived from the tropical flora of the West Indies (FNAI 2010, p. 61). Many of these species vary in height depending on fire frequency, getting taller with time since fire. These include saw palmetto (*Serenoa repens*), cabbage palm (*Sabal palmetto*), silver palm (*Coccothrinax argentata*), brittle thatch palm (*Thrinax morrisii*), wax myrtle (*Myrica cerifera*), myrsine (*Rapanea punctata*), poisonwood (*Metopium toxiferum*), locustberry (*Byrsonima lucida*), varnishleaf (*Dodonaea viscosa*), tetrazygia (*Tetrazygia bicolor*), rough velvetseed (*Guettarda scabra*), marlberry (*Ardisia escallonioides*), mangrove berry (*Psidium*

*longipes*), willow bastic (*Sideroxylon salicifolium*), and winged sumac (*Rhus copallinum*).

Short-statured shrubs include running oak (*Quercus elliotii*), white indigoberry (*Randia aculeata*), Christmas berry (*Crossopetalum ilicifolium*), redgal (*Morinda royoc*), and snowberry (*Chiococca alba*).

Grasses, forbs, and ferns make up a diverse herbaceous layer ranging from mostly continuous in areas with more soil development and little exposed rock to sparse where more extensive outcroppings of rock occur. Typical herbaceous species include bluestems (*Andropogon* spp., *Schizachyrium gracile*, *S. rhizomatum*, and *S. sanguineum*), arrowleaf threeawn (*Aristida purpurascens*), lopsided indiagrass (*Sorghastrum secundum*), hairawn muhly (*Muhlenbergia capillaris*), Florida white-top sedge (*Rhynchospora floridensis*), pineland noseburn (*Tragia saxicola*), devil's potato (*Echites umbellata*), pineland croton, several species of sandmats (*Chamaesyce* spp.), partridge pea (*Chamaecrista fasciculata*), coontie (*Zamia pumila*), maidenhair pineland fern (*Anemia adiantifolia*), Bahama brake (*Pteris bahamensis*), and lacy bracken (*Pteridium aquilinum* var. *caudatum*) (FNAI 2010, p. 62).

Pine rockland occurs on relatively flat, moderately to well drained terrain from 2 to 7 m (6.5 to 23 ft) above sea level (FNAI 2010, p. 62). The oolitic limestone is at or very near the surface, and there is very little soil development. Soils are generally composed of small accumulations of nutrient-poor sand, marl, clayey loam, and organic debris in depressions and crevices in the rock surface. Organic acids occasionally dissolve the surface limestone causing collapsed depressions in the surface rock called solution holes (FNAI 2010, p. 62). Drainage varies according to the porosity of the limestone substrate, but is generally rapid. Consequently, most sites are wet for only short periods following heavy rains. During the rainy season,

however, some sites may be shallowly inundated by slow-flowing surface water for up to 60 days each year (FNAI 2010, p. 62).

Pine rockland is maintained by regular fire, and susceptible to other natural disturbances such as hurricanes, frost events, and sea-level rise (Ross *et al.* 1994, pp. 144–156). Fires historically burned on an interval of approximately every 3 to 7 years (FNAI 2010, p. 63) and were typically started by lightning strikes during the frequent summer thunderstorms (FNAI 2010, p. 63).

Presently, prescribed fire must be periodically introduced into pine rocklands to sustain community structure, prevent invasion by woody species, maintain high herbaceous diversity (Loope and Dunevitz 1981, pp. 5–6; FNAI 2010, p. 63), and prevent succession to rockland hammock. The amount of woody understory growth is directly related to the length of time since the last fire. Herbaceous diversity declines with time since last fire. The ecotone between pine rockland and rockland hammock is abrupt when regular fire is present in the system. However when fire is removed, the ecotone becomes more gradual and subtle as hammock hardwoods encroach into the pineland (FNAI 2010, p. 63).

### *Marl Prairie*

Marl prairie is a sparsely vegetated, grass-dominated community found on marl substrates in South Florida. Marls are fine white calcareous muds formed from calcite precipitated by a mixture of green algae, blue green algae, and diatoms, known as periphyton. It is seasonally inundated (2 to 4 months) to a shallow depth averaging about 20 cm (8 in). Marl prairie is a diverse community, which may contain more than 100 species. Most of the marl prairie plant species contribute little cover and more than 90 percent of the cover is contributed by only two or three dominant species in any given area (FNAI 2010, p. 107). Dominants may

include one or more of the following: Gulf hairawn muhly (*Muhlenbergia sericea*), spreading beaksedge (*Rhynchospora divergens*), Florida little bluestem (*Schizachyrium rhizomatum*), black bogrush (*Schoenus nigricans*), Elliott's lovegrass (*Eragrostis elliottii*), sand cordgrass (*Spartina bakeri*), and a short form of sawgrass (*Cladium jamaicense*) (Porter, Jr. 1967, pp. 937–942; FNAI 2010, p. 107). (Taxonomy of *Schizachyrium* and *Muhlenbergia* follows treatments in Flora of North America (2007)). Other characteristic species include southern beaksedge (*Rhynchospora microcarpa*), bluejoint panicum (*Panicum tenerum*), Gulfdune paspalum (*Paspalum monostachyum*), rosy camphorweed (*Pluchea rosea*), starrush whitetop (*Rhynchospora colorata*), alligator lily (*Hymenocallis palmeri*), arrowfeather threeawn (*Aristida purpurascens*), and narrowleaf yellowtops (*Flaveria linearis*) (Porter, Jr. 1967, pp. 937–942; FNAI 2010, p. 107).

Marl prairie depends on a short hydroperiod of 2 to 4 months. Longer hydroperiods favor the development of peat and the dominance of sawgrass; shorter hydroperiods permit the invasion of woody species.

Marl prairie normally dries out during the winter and is subject to fires at the end of the dry season; the most acres naturally burn in May (FNAI 2010, p. 108). Fires at this time (in contrast to dormant season fires) stimulate flowering of the dominant grasses (Main and Barry 2002, pp. 430–434). The herbaceous species recover rapidly from fire, and biomass reaches pre-fire levels at the end of 2 years. For the first 2 years after fire, this community will burn only patchily, if at all (FNAI 2010, p. 108). Reasons for the presence of dwarf cypress in some marl prairies and not others are unknown (FNAI 2010, p. 108). Wade *et al.* (1980, pp. 67–79) estimated dwarf cypress stands in marl prairie burn about once a decade due to low fire-carrying capacity of their sparse understory.

## Historical Range

All known historical and current records for *Sideroxylon reclinatum* ssp. *austrofloridense* are summarized in table 1. The historical range of *S. reclinatum* ssp. *austrofloridense* is limited to Collier, Miami-Dade, and Monroe Counties, Florida. In Miami-Dade County, the plant was known from central and southern Miami-Dade County along the Miami Rock Ridge, which extends from Long Pine Key in the Everglades northward through urban Miami to the Miami River. In Monroe County, the plant was known from BCNP on the mainland, and was collected as far south as Key Largo, in the Florida Keys. In Collier County, the species has been recorded only within BCNP. This area constitutes a historical range of approximately 42 miles (mi) (66 kilometers (km)) (Gann *et al.* 2002, p. 526; Corogin and Judd 2014, p. 412).

## Current Range, Population Estimates, and Status

The current range of *Sideroxylon reclinatum* ssp. *austrofloridense* is BCNP, the Long Pine Key region of Everglades National Park (ENP), and pine rocklands adjacent to ENP (Hodges and Bradley 2006, p. 42; Gann *et al.* 2006, p. 11; K. Bradley, pers. comm. 2007; J. Possley, pers. comm. 2011a; 2011b; J. Sadle, pers. comm. 2011; Bradley *et al.* 2013, p. 4; Gann 2015, p. 30). The species is apparently extirpated from Key Largo. Hodges and Bradley (2006, p. 42) did not find *Sideroxylon reclinatum* ssp. *austrofloridense* in their surveys of pine rocklands on Key Largo, Big Pine Key, Cudjoe Key, and Lower Sugarloaf Key. This area constitutes a current range of approximately 42 mi (66 km) (Gann *et al.* 2002, p. 526; Corogin and Judd 2014, p. 412).



The largest population occurs at Long Pine Key in ENP (Hodges and Bradley 2006, p. 42; Gann *et al.* 2006, p. 11; Gann 2015, p. 9). The most recent information indicates that the baseline abundance estimate at Long Pine Key based on a log<sub>10</sub> abundance estimate is 10,000–100,000 plants (Gann *et al.* 2006, pp. 9–11; Gann 2015, p. 29). Recent surveys of ENP have identified 14 occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense* in Long Pine Key, expanding the known range in ENP (Gann 2015, p. 30).

In Miami-Dade County, outside ENP, pine rocklands tracts are orders of magnitude smaller and exist in a matrix of agricultural, commercial, and residential development. Possley and McSweeney (2005, p. 1) observed approximately 73 plants at Larry and Penny Thompson Park, within the Richmond Pine Rocklands. Possley (Fairchild Tropical Botanic Garden (FTBG), pers. comm. 2011a; 2011b) found extant populations at Quail Roost Pineland (two plants), Navy Well Pineland Preserve (four plants), and Sunny Palms Pinelands (two plants). The species had been observed in pine rocklands at Grant Hammock, and Pine Ridge Sanctuary (Bradley *et al.* 2013, p. 1). The species no longer occurs at the Nixon-Smilely Preserve.

Bradley *et al.* (2013, pp. 1–8) conducted surveys in the Gum Slough region of Lostmans Pines in BCNP and reported finding *Sideroxylon reclinatum* ssp. *austrofloridense* to have limited distribution within the study area. Seventeen plants were counted within pine rockland plots that were associated with marl prairie habitats (Bradley *et al.* 2013, p. 4).

Table 1. Summary of the status and trends of the known occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense*.

Population	Ownership	Most Recent Population Estimate (Year)	Status	Trend
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Everglades National Park	National Park Service	10,000–100,000 (2013)	Extant	Increasing
Big Cypress National Preserve	National Park Service	17 (2013)	Extant	Insufficient data
Larry Penny Thompson Park	Miami-Dade County	73 (2005)	Extant	Insufficient data
Nixon-Smiley Preserve	Miami-Dade County	0 (Unknown)	Extirpated	-
Navy Wells Pineland Preserve	Miami-Dade County	4 (2011)	Extant	Insufficient data
Sunny Palms Pineland	Miami-Dade County	2 (2011)	Extant	Insufficient data
Pine Ridge Sanctuary	Private	Unknown	Extant	Insufficient data
Lucille Hammock	Miami-Dade County	11–100 (2007)	Extant	Insufficient data
South Dade Wetlands	Miami-Dade County	Unknown (2007)	Extant	Insufficient data
Natural Forest Community #P-300	Private	2–10 (2007)	Extant	Insufficient data
Natural Forest Community #P-310	Private	11–100 (2007)	Extant	Insufficient data
Quail Roost Pineland	Miami-Dade County	2 (2011)	Extant	Insufficient data
Grant Hammock	Unknown	Unknown (Unknown)	Extirpated	-
Key Largo	Unknown	No estimate (1948)	Extirpated	-

## Biology

### *Life History and Reproduction*

Little is known about the life history of *Sideroxylon reclinatum* ssp. *austrofloridense*, including pollination biology, seed production, and dispersal (Gann 2015, p. 31). Reproduction is sexual, with new plants generated from seeds. The species produces flowers from April to May, and fruit ripen from June to July (Corogin and Judd 2014, pp. 410–412). The plants can stand partial inundation with fresh water for a portion of the year, but do not tolerate salinity.

### *Fire Ecology and Demography*

There have been no detailed studies of *Sideroxylon reclinatum* ssp. *austrofloridense* relationship towards fire; however, periodic fire is extremely important to maintaining habitat for this species (Corogin and Judd 2014, p. 414). Therefore, historical declines have been partially attributed to habitat loss from fire suppression or inadequate fire management (ENP 2014, p. 173).

### *Digitaria pauciflora* (Florida pineland crabgrass)

#### Species Description

*Digitaria pauciflora* is a small perennial clump-grass, appearing blue-green to gray with reddish-brown stems, typically 0.5–1 m (1.5–3 ft) tall (Small 1933, p. 51). The leaves form a subtle zig-zag pattern as the leaf blades come off the stem at an angle. The leaf blades are 7–18 cm (2.8–7.1 in) long, 1.0–2.2 mm (0.04–0.08 in) wide, and number 2–8 per stem. Both the lower and upper surface and stems are hairy but become glabrous (smooth or hairless) with age. The nodes are mostly glabrous, the sheath auricles (an ear-like projection at the base of the leaf) are 1.5 mm (0.06 in) long, and the sheaths are hairy but becoming glabrous with age. The ligule (a small bract located at the leaf-stem junction) is 1.5–2.0 mm (0.06–0.08 in) long. The flowers are dull green, very small, and are borne on wispy spikes on the ends of the leafy stems, with usually only a few flower clusters forming per clump of grass. The lemma (a tiny bract adjacent to the flower) of upper floret (flower) is purple. Stolons (aboveground horizontal stems) are not present, but the plant produces rhizomes (belowground horizontal stems) that allow for vegetative spread (Webster and Hatch, 1990, pp. 161–162). *Digitaria pauciflora* is known to reproduce sexually (Bradley and Gann 1999, p. 50), with fruit production in the fall (Wendelberger and Maschinski 2006, p. 3).

## Taxonomy

*Digitaria pauciflora* was first described in 1928 based on specimens collected in 1903 (Bradley and Gann 1999, p. 49). Small (1933, pp. 50–51) later placed it in the genus *Syntherisma*. Subsequent authors (Hitchcock 1935, p. 561; Webster & Hatch 1990, p. 161; Wunderlin 1998) have retained it in the genus *Digitaria* (Bradley and Gann 1999, p. 49).

The online Atlas of Florida Vascular Plants uses the name *Digitaria pauciflora* (Wunderlin and Hansen 2016, p. 1), the Integrated Taxonomic System (ITIS 2016, p. 1), NatureServe (2016, p. 1), and the Florida Department of Agriculture and Consumer Services (FDACS) (Coile and Garland 2003, p. 19) indicates that its taxonomic status is accepted. We have carefully reviewed all taxonomic data to determine that *Digitaria pauciflora* is a valid taxon. The only synonym is *Syntherisma pauciflora* (Hitchcock) Hitchcock ex Small (ITIS 2016, p. 1).

## Climate

The climate of south Florida where *Digitaria pauciflora* occurs is classified as tropical savanna, as described above for *Sideroxylon reclinatum* ssp. *austrofloridense*.

## Habitat

*Digitaria pauciflora* occurs predominantly within the seasonally flooded ecotone between pine rockland and marl prairie, although the species may overlap somewhat into both habitats (Bradley and Gann 1999, p. 49; Fellows *et al.* 2002, p. 79). Plants can withstand inundation with fresh water for one to several months each year (ENP 2014, p. 172). These

habitats are maintained by regular fire, and are prone, particularly marl prairie, to annual flooding for several months during the wet season (Gann *et al.* 2006, p. 13). Pine rocklands and marl prairies are described in detail above for *Sideroxylon reclinatum* ssp. *austrofloridense*.

## Historical Range

All known historical and current records for *Digitaria pauciflora* are summarized in table 2. The historical range of *D. pauciflora* consists of central and southern Miami-Dade County along the Miami Rock Ridge, from the southern Miami to Long Pine Key region of ENP, a range of approximately 42 mi (67.6 km) (Bradley and Gann 1999, p. 49). Specimens of *D. pauciflora* were collected early in the twentieth century throughout Miami-Dade County.

*D. pauciflora* was absent from collections from 1939 until 1973, when it was rediscovered at Long Pine Key in Everglades National Park (Bradley and Gann 1999, p. 49). *D. pauciflora* has subsequently been encountered consistently within Long Pine Key (Bradley and Gann 1999, p. 49).

A single *Digitaria pauciflora* plant was discovered in 1995 within marl prairie habitat at the Martinez Pinelands in the Richmond Pine Rocklands, an area of Miami-Dade County that retains the largest contiguous areas of pine rockland habitat outside of the Everglades. However, this plant has since disappeared (Herndon 1998, p. 88; Bradley and Gann 1999, p. 49; Gann 2015, p. 142). Three other historical occurrences in Miami-Dade County have been documented: (1) a site between Cutler and Longview Camp (last observed in 1903); (2) Jenkins Homestead (date unspecified); and (3) South Miami (last observed in 1939) (K. Bradley, pers. comm. 2007); however, little is known regarding the status of these populations. The species was not found during a 2-year project to survey and map rare and exotic plants along Florida Department of

Transportation (FDOT) right-of-ways within Miami-Dade and Monroe Counties (Gordon *et al.* 2007, pp. 1, 38).

#### Current Range, Population Estimates, and Status

The current range of *Digitaria pauciflora* includes ENP and BCNP (Bradley and Gann 1999, p. 49; Gann *et al.* 2006, p. 3; Bradley, pers. comm. 2005a; Gann 2015, p. 142). Ongoing surveys suggest the species occurs throughout Long Pine Key of ENP (Gann *et al.* 2006, p. 7; 2015, p. 144; Gann 2015, p. 144) and is much wider-ranging than previously known in ENP. Joyce Maschinski (FTBG, pers. comm. 2007) characterized the populations within ENP as abundant.

In 2002, Bradley *et al.* (2013, p. 2) discovered *Digitaria pauciflora* within the Lostmans Pines region of BCNP in Monroe County. This discovery represented the first known *D. pauciflora* occurrence outside Miami-Dade County (FNAI 2007, p. 191). The species is widely distributed within Lostmans Pines (Bradley *et al.* 2013, pp. 1–8). Subsequent surveys for the species within BCNP have documented up to nine occurrences, some of which contain an estimated 500–600 plants (Maschinski *et al.* 2003, p. 141). Bradley *et al.* (2013, pp. 1–8) conducted surveys in the Gum Slough region of Lostmans Pines and indicated that the species is widely distributed within the study area. A total of 2,365 plants was counted within pineland and sawgrass based survey plots (Bradley *et al.* 2013, pp. 3–4). The range-wide population estimate for *D. pauciflora* is 1,000–10,000 individuals at Long Pine Key (Gann 2015, p. 142) and >10,000 individuals within BCNP (K. Bradley, pers. comm. 2007). Large-scale stochastic events such as wildfire and flooding can drastically reduce the size of *D. pauciflora* populations. For example, in the spring months of 2016, wildfires in areas occupied by *D. pauciflora* likely

reduced populations in ENP. The populations will likely rebound; however, regeneration could be severely hampered, based on the amount and duration of flooding during the region's late summer storm season. While *Digitaria pauciflora* populations remain abundant within ENP and BCNP, these areas represent only half of the species' historical range (Bradley and Gann 1999, p. 25; Gann 2015, p. 167). While *D. pauciflora* was known to occur throughout Miami-Dade County, all other populations are likely extirpated.

Table 2. Summary of the status and trends of the known occurrences of *Digitaria pauciflora*.

<b>Population</b>	<b>Ownership</b>	<b>Most Recent Population Estimate</b>	<b>Status</b>	<b>Trend</b>
Everglades National Park	National Park Service	1,000–10,000 (2007)	Extant	Stable
Big Cypress National Preserve	National Park Service	>10,000 (2007)	Extant	Stable
Martinez Pineland	Miami-Dade County	0 (1999)	Extirpated	-
Cutler and Longview Camp	Unknown	Unknown (1903)	Extirpated	-
Jenkins Homestead	Unknown	Unknown (date unspecified)	Extirpated	-
South Miami	Unknown	Unknown (1939)	Extirpated	-

## Biology

### *Life History and Reproduction*

Little is known about the life history of *Digitaria pauciflora*, including pollination biology, seed production, and dispersal. Reproduction is sexual, with new plants generated from seeds (Bradley and Gann, 1999, p. 53). The species produces flowers from summer to late fall on both new and older growth; some plants have been observed to finish seeding as late as December (Fellows *et al.* 2002, p. 2; Gann 2015, p. 172). Plants can also spread clonally via

rhizomes (Webster and Hatch, 1990, pp. 161–162). The plants can stand partial inundation with fresh water for a portion of the year, but do not tolerate salinity.

### *Fire Ecology and Demography*

*Digitaria pauciflora* population demographics and longevity have not been studied (Bradley and Gann, 1999, p. 53; Fellows *et al.* 2002, p. 2). There have been no studies of the plant's relationship to fire; however, periodic fire is extremely important to maintaining habitat for this species (Bradley and Gann, 1999, p. 53; ENP 2014, p. 226). Therefore, historical declines have been partially attributed to habitat loss from fire suppression or inadequate fire management. Gann (2015, p. 142) indicates that the species shows patch dynamics, colonizing new areas and undergoing local extinctions with high rates of turnover. Plants with 'flashy' or 'boom and bust' demographic patterns are more susceptible to stochastic extinction events. ENP has burned populations of *D. pauciflora* during the wet and dry season, and both appear suitable to maintain populations of the plant (ENP 2014, p. 226).

### *Chamaesyce deltoidea* spp. *pinetorum* (pineland sandmat)

#### Species Description

*Chamaesyce deltoidea* ssp. *pinetorum* is an ascending to erect perennial herb. The stems are villous (hairy), and often reddish. The leaf blades range from kidney-shaped or triangle-shaped and elliptic to oval. The involucre (a cup-like structure enclosing the flowers) are 1 mm long, and pubescent, and possess green, even-edged glands with very narrow appendages. The fruit is a 2-mm broad, pubescent capsule. The seeds are 1 mm long, transversely wrinkled, and yellowish in color (Small 1933, p. 795). *C. deltoidea* ssp. *pinetorum* is known to reproduce



sexually (Bradley and Gann 1999, p. 25). Fruit production is year-round, with a peak in the fall (Wendelberger and Maschinski 2006, p. 2).

## Taxonomy

*Chamaesyce deltoidea* ssp. *pinetorum* was first described by Small in 1905, based on specimens collected in eastern Miami-Dade County (Small 1905, pp. 429–430). Initially, Small referred to these specimens as *C. pinetorum* but recognized that it was closely related to *Chamaesyce deltoidea*. Herndon (1993, pp. 38–51) included *C. pinetorum* within the *C. deltoidea* complex, which is composed of three other taxa, two occurring further north on the Miami Rock Ridge, and one occurring on Big Pine Key in the lower Florida Keys (Monroe County). The three taxa on the Miami Rock Ridge have distinct, but adjacent ranges. Subsequently, Herndon (1993, pp. 38–51) has placed all four taxa at the same taxonomic level, treating each as a distinct subspecies under *Chamaesyce deltoidea* (*C. deltoidea* ssp. *pinetorum*; *C. deltoidea* ssp. *serpyllum*, *C. deltoidea* ssp. *adhaerens*; *C. deltoidea* ssp. *deltoidea*). *Chamaesyce deltoidea* ssp. *deltoidea* and *C. deltoidea* ssp. *adhaerens* occur north of known *C. deltoidea* ssp. *pinetorum* populations, while *Chamaesyce deltoidea* ssp. *serpyllum* is endemic to Big Pine Key. Wunderlin and Hansen (2016, p. 1) follow Herndon's treatment in using *C. deltoidea* ssp. *pinetorum*. Some modern authors place the genus *Chamaesyce* into the genus *Euphorbia sensu lato* (Yang and Berry 2011, pp. 1486–1503). Gann (2015, p. 168) indicates that if the pineland sandmat is placed into the genus *Euphorbia*, the correct name is *Euphorbia deltoidea* ssp. *pinetorum*.

The online Atlas of Florida Vascular Plants uses the name *Chamaesyce deltoidea* ssp. *pinetorum* (Small) Herndon (Wunderlin and Hansen 2016, p. 1). NatureServe (2016, p. 1) and

FDACS (Coile and Garland 2003, p. 11) indicate that *C. deltoidea* ssp. *pinetorum* is accepted. However, the Integrated Taxonomic System (ITIS 2016, p. 1) accepts *Euphorbia deltoidea* ssp. *pinetorum* as the scientific name for the species (Gann 2015, p. 168). We have carefully reviewed all taxonomic data and have determined that *C. deltoidea* ssp. *pinetorum* is a valid taxon.

## Climate

The climate of south Florida where *Chamaesyce deltoidea* ssp. *pinetorum* occurs is classified as tropical savanna, as described above for *Sideroxylon reclinatum* ssp. *austrofloridense*.

## Habitat

*Chamaesyce deltoidea* ssp. *pinetorum* occurs in pine rocklands (Bradley and Gann 1999, p. 24). Pine rocklands are maintained by regular fire, and are prone to annual flooding for several months during the wet season (Gann *et al.* 2006, p. 13). However, Gann (2015, p. 169), indicates that *C. deltoidea* ssp. *pinetorum* generally occurs in higher elevation pine rocklands at Long Pine Key in ENP, in areas rarely subject to flooding. Pine rockland habitat is described in detail above in the Habitat section for *Sideroxylon reclinatum* ssp. *austrofloridense*.

## Historical Range

All known historical and current records for *Chamaesyce deltoidea* ssp. *pinetorum* are summarized in table 3. *Chamaesyce deltoidea* ssp. *pinetorum* occurred historically only within the southern portion of the Miami Rock Ridge, from the Richmond Pine Rocklands of southern

Miami to the Long Pine Key region of Everglades National Park, a range of approximately 42 mi (67.6 km) (Bradley and Gann 1999, p. 24). *C. deltoidea* ssp. *pinetorum* has been encountered consistently within Long Pine Key, as well as in several County-owned conservation lands adjacent to the ENP (Gann 2015, p. 167).

#### Current Range, Population Estimates, and Status

The current range of *Chamaesyce deltoidea* ssp. *pinetorum* is similar to the historical range, although 98 percent of the pine rocklands (the species' only habitat) outside of the ENP has been lost to development (Kernan and Bradley 1996, p. 2). The total population size of *Chamaesyce deltoidea* ssp. *pinetorum* is estimated to be between 14,500–146,000 individuals, with the majority of the population occurring on Long Pine Key (Bradley and Gann 1999, p. 25; Gann 2015, p. 167). However, while *Chamaesyce deltoidea* ssp. *pinetorum* is most abundant within ENP, pine rockland fragments outside of the Everglades represent about half the species' extant range (Bradley and Gann 1999, p. 25; Bradley pers. comm. 2007; Gann 2015, p. 167). Elsewhere in Miami-Dade County, a 2011 survey of the privately owned Pine Ridge Sanctuary confirmed the plant remains at this site (FNAI 2011, p. 5). A recent survey of Larry and Penny Thompson Park located no individuals (J. Possley, FTBG, pers. comm. 2011c).

Table 3. Summary of the status and trends of the known occurrences of *Chamaesyce deltoidea* ssp. *pinetorum*.

Population	Ownerhip	Most Recent Population Estimate	Status	Trend
Everglades National Park	National Park Service	10,000–100,000 (2011)	Extant	Increasing
Florida City	Miami-Dade County	100–1,000	Extant	Increasing

Pineland		(2007)		
Navy Wells	Miami-Dade County	1,000–10,000 (2007)	Extant	Insufficient data
Navy Wells #2	Miami-Dade County	100–1,000 (2007)	Extant	Insufficient data
Navy Wells #39	Miami-Dade County	1,000–10,000 (2007)	Extant	Insufficient data
Palm Drive Pineland	Miami-Dade County	10–100 (2007)	Extant	Insufficient data
Pine Ridge Sanctuary	Private	10–100 (2011)	Extant	Insufficient data
Rock Pit #39	Miami-Dade County	11–1,000 (2007)	Extant	Insufficient data
Seminole Wayside Park	Miami-Dade County	100–1,000 (2007)	Extant	Insufficient data
Fuchs Hammock Addition	Miami-Dade County	11–100 (2007)	Extant	Insufficient data
Sunny Palms Pineland	Miami-Dade County	100–1,000 (2007)	Extant	Insufficient data
Larry and Penny Thompson Park	Miami-Dade County	0 (2011)	Extirpated	Insufficient data
John Kunkel Small Pineland	Institute for Regional Conservation	Present (2006)	Extant	Insufficient data
Natural Forest Community [NFC] #P330	private	11–100 (2007)	Extant	Insufficient data
Natural Forest Community #P338	Private	1,001–10,000 (2007)	Extant	Insufficient data
Natural Forest Community #P339	Private	11–100 (2007)	Extant	Insufficient data
Natural Forest Community #P347	Private	11–100 (2007)	Extant	Insufficient data
Natural Forest Community #P411	Private	101–1,000 (2007)	Extant	Insufficient data
Natural Forest Community #P413	Private	11–100 (2007)	Extant	Insufficient data
Natural Forest Community #P416	Private	11–100 (2007)	Extant	Insufficient data
Natural Forest Community #P445	Private	1,001–10,000 (2007)	Extant	Insufficient data

## Biology

### *Life History and Reproduction*

Little is known about the life history of *Chamaesyce deltoidea* ssp. *pinetorum*. Reproduction is sexual, but little is known about the reproductive biology and ecology of the species (Bradley and Gann 1999, p. 25; Gann 2015, p. 167). Herndon (1998, pp. 13–14) studied the life history and population trends of *C. deltoidea* ssp. *pinetorum* and found up to 88 percent of plants survived more than 3 years, showing that it is a somewhat long-lived taxon. Herndon (1998, pp. 13–14) hypothesized that some of the plants that had been recorded as dead may have instead been in a cryptic phase (Gann 2015, p. 167). The extensive root system of *C. deltoidea* ssp. *pinetorum* also suggests that it is a long-lived plant (Maschinski *et al.* 2003, p. 179). Pollinators are unknown; other species of *Chamaesyce* are completely reliant on insects for pollination and seed production, while others are self-pollinating (Maschinski *et al.* 2003, p. 179; Gann 2015, p. 168). Pollinators may include bees, flies, ants, and wasps (Ehrenfeld 1979, p. 95; Gann 2015, p. 168). Dispersal is unknown for *Chamaesyce deltoidea* ssp. *pinetorum*; however, many seed capsules in similar *Chamaesyce* species are explosively dehiscent, a form of dispersal that flings seeds far from the parent plant (Maschinski *et al.*, p. 179; Gann 2015, p. 168). This species is known to flower and fruit year round (Wendelberger and Maschinski 2006, p. 2). Peaks in fruiting for *C. deltoidea* ssp. *pinetorum* occur in the fall and are stimulated by fire (Wendelberger and Maschinski 2006, p. 2). The plants can stand partial inundation with fresh water for a portion of the year, but do not tolerate salinity.

#### *Fire Ecology and Demography*

There have been no studies of *Chamaesyce deltoidea* ssp. *pinetorum* population demographics. However, the species is not shade tolerant, and it requires periodic low-intensity fires to reduce competition by woody species to maintain habitat for this species (Bradley and

Gann, 1999, p. 26; ENP 2014, p. 170). Therefore, historical declines have been partially attributed to habitat loss from fire suppression or inadequate fire management.

*Dalea carthagenensis* var. *floridana* (Florida prairie-clover)

Species Description

*Dalea carthagenensis* var. *floridana* is a short-lived (less than 7 years) perennial shrub 2.6–9.8 ft (0.8–3.0 m) tall with a light-brown woody stem and non-woody, light-brown or reddish branches. The leaves are composed of 9–15 oval, gland-tipped leaflets, and are gland-dotted on the underside. The flowers are in small loose heads at ends of hairy, glandular stalks, less than 0.4 in long. The flower color is white and maroon; each of the petals is different lengths and shapes. The fruit is a small one-seeded pod, mostly enclosed by the hairy, gland-dotted calyx (bracts at base of each flower) (adapted from Long and Lakela 1971, p. 478; Bradley and Gann 1999, p. 42; Maschinski *et al.* 2014, p. 44).

Taxonomy

Chapman (1886, p. 102) was the first to report this taxon in Florida, calling it the tropical *Dalea domingensis*, based on specimens collected on Key Biscayne. Small (1913, p. 89) accepted this characterization but included the taxon in the genus *Parosela*, making the plant *P. domingensis*. Rydberg (1920, p. x) renamed the plant, calling it *Parosela floridana*, and this name was retained by Small (1933, pp. 694–695). Clausen (1946a, p. 85) reviewed the taxonomy of Florida and West Indian *Dalea* and considered them all to be the same species. Clausen (1946a, p. 85) also found that the name *D. domingensis* was a homonym of *D. emphysodes*, and published the name *D. emphysodes* ssp. *domingensis*. Clausen (1946b, p. 572)

later discovered that his use of the name *D. emphyisodes* was in error, and renamed the plants *D. carthagenensis* ssp. *domingensis*. Long and Lakela (1971, p. 478) accepted this usage. Barneby (1977), in a monograph of the genus, also found that Florida plants were distinct from West Indian plants, citing differences in leaf characters, naming the Florida species *D. carthagenensis* var. *floridana*. Wunderlin (1998) has followed this treatment.

The Integrated Taxonomic Information System (2016, p. 1) indicates that the taxonomic standing for *Dalea carthagenensis* var. *floridana* (Rydb.) Barneby is accepted. The online Atlas of Florida Vascular Plants (Wunderlin and Hansen 2016, p. 1) uses the name *D. carthagenensis* var. *floridana*, as does NatureServe (2016, p. 1). FDACS uses the name *Dalea carthagenensis* and notes that *D. carthagenensis* var. *floridana* is endemic (Coile and Garland 2003, p. 17). In summary, there is consensus that *D. carthagenensis* var. *floridana* is a distinct taxon. We have carefully reviewed the available taxonomic information to reach the conclusion that *D. carthagenensis* var. *floridana* is a valid taxon.

## Climate

The climate of south Florida where *Dalea carthagenensis* var. *floridana* occurs is classified as tropical savanna as described above for *Sideroxylon reclinatum* ssp. *austrofloridense*.

## Habitat

*Dalea carthagenensis* var. *floridana* grows in pine rockland, rockland hammock, marl prairie, coastal berm, and in the ecotones between these habitats (Bradley and Gann 1999, p. 43). The species may also occur along roadsides within these habitats (Gann *et al.* 2006, p. 10). Pine

rockland and marl prairie habitat are described in detail above in the Habitat section for *Sideroxylon reclinatum* ssp. *austrofloridense*.

### *Roadsides*

Roadsides are a potentially important habitat for *Dalea carthagenensis* var. *floridana* (Bradley and Gann 1999, p. 43). Where endemics such as *D. carthagenensis* var. *floridana* are found on shoulders, the ground cover is dominated mostly by native herbs and grasses where exotic lawn grasses have not been planted. Maintaining the roadsides in this condition through regular mowing, without planting sod, should continue to provide suitable habitat for *Dalea carthagenensis* var. *floridana* (Bradley 2006, p. 37).

### *Rockland Hammock*

Rockland hammock is a species-rich tropical hardwood forest on upland sites in areas where limestone is very near the surface and often exposed. The forest floor is largely covered by leaf litter with varying amounts of exposed limestone and has few herbaceous species. Rockland hammocks typically have larger, more mature trees in the interior, while the margins can be almost impenetrable in places with dense growth of smaller shrubs, trees, and vines. Typical canopy and subcanopy species include *Bursera simaruba*, *Lysiloma latisiliquum* (false tamarind), *Coccoloba diversifolia* (pigeon plum), *Sideroxylon foetidissimum* (false mastic), *Ficus aurea* (strangler fig), *Piscidia piscipula* (Jamaican dogwood), *Ocotea coriacea* (lancewood), *Drypetes diversifolia*, *Simarouba glauca* (paradisetree), *Sideroxylon salicifolium* (willow bustic), *Krugiodendron ferreum* (black ironwood), *Exothea paniculata* (inkwood), *Metopium toxiferum*, and *Swietenia mahagoni* (West Indies mahogany). Mature hammocks may be open beneath a tall, well-defined canopy and subcanopy. More commonly, in less mature or disturbed hammocks, dense woody vegetation of varying heights from canopy to short shrubs is often



present. Species that generally make up the shrub layers within rockland hammock include several species of *Eugenia* (stoppers), *Thrinax morrisii* and *T. radiata* (thatch palms), *Amyris elemifera* (sea torchwood), *Ardisia escallonioides* (marlberry), *Psychotria nervosa* (wild coffee), *Chrysophyllum oliviforme* (satinleaf), *Sabal palmetto* (cabbage palm), *Guaiacum sanctum* (lignum-vitae), *Ximenia americana* (tallow wood), *Colubrina elliptica* (soldierwood), *Pithecellobium unguis-cati* (cat claw blackbead) and *Pithecellobium keyense* (Florida keys blackbead), *Coccoloba uvifera* (sea grape), and *Colubrina arborescens* (greenheart). Vines can be common and include *Toxicodendron radicans* (eastern poison ivy), *Smilax auriculata* (earleaf greenbrier), *Smilax havanensis* (Everglades greenbrier), *Parthenocissus quinquefolia* (Virginia creeper), *Hippocratea volubilis* (medicine vine), and *Morinda royoc* (redgal). The typically sparse, short shrub layer may include *Zamia pumila* (coontie) and *Acanthocereus tetragonus* (triangle cactus). Herbaceous species are occasionally present and generally sparse in coverage. Characteristic species include *Lasiacis divaricata* (smallcane), *Oplismenus hirtellus* (basketgrass), and many species of ferns (FNAI 2010, p. 24).

Rockland hammock occurs on a thin layer of highly organic soil covering limestone on high ground that does not regularly flood, but it is often dependent upon a high water table to keep humidity levels high. Rockland hammocks are frequently located near wetlands; in the Everglades they can occur on organic matter that accumulates on top of the underlying limestone (FNAI 2010, p. 25).

Rockland hammock is susceptible to fire, frost, canopy disruption, and ground water reduction. Rockland hammock can be the advanced successional stage of pine rockland, especially in cases where rockland hammock is adjacent to pine rockland. In such cases, when fire is excluded from pine rockland for 15 to 25 years, it can succeed to rockland hammock

vegetation. Historically, rockland hammocks in south Florida evolved with fire in the landscape. Fire most often extinguished near the edges when it encountered the hammock's moist microclimate and litter layer. However, rockland hammocks are susceptible to damage from fire during extreme drought or when the water table is lowered. In these cases, fire can cause tree mortality and consume the organic soil layer (FNAI 2010, p. 25).

Rockland hammocks are also sensitive to the strong winds and storm surge associated with infrequent hurricanes. Canopy damage often occurs, which causes a change in the microclimate of the hammock. Decreased relative humidity and drier soils can leave rockland hammocks more susceptible to fire. Rockland hammock can transition into glades marsh, mangrove swamp, salt marsh, coastal rock barren, pine rockland, maritime hammock, or marl prairie (FNAI 2010, p. 26).

The sparsely vegetated edges or interior portions laid open by canopy disruption are the areas of rockland hammock that have light levels sufficient to support *Dalea carthagenensis* var. *floridana*. However, the dynamic nature of the habitat means that areas not currently open may become open in the future as a result of canopy disruption from hurricanes, while areas currently open may develop more dense canopy over time, eventually rendering that portion of the hammock unsuitable for *Dalea carthagenensis* var. *floridana*.

#### *Coastal Berm*

Coastal berms are landscape features found along low-energy coastlines in south Florida and the Florida Keys. Coastal berm is a short forest or shrub thicket found on long, narrow, storm-deposited ridges of loose sediment formed by a mixture of coarse shell fragments, pieces of coralline algae, and other coastal debris. These ridges parallel the shore and may be found on the seaward edge or landward edge of the mangroves or farther inland depending on the height of

the storm surge that formed them. They range in height from 0.30 to 3.05 m (1 to 10 ft).

Structure and composition of the vegetation is variable depending on height and time since the last storm event. The most stable berms may share some tree species with rockland hammocks, but generally have a greater proportion of shrubs and herbs. Tree species may include *Bursera simaruba* (gumbo limbo), *Coccoloba uvifera* (seagrape), *Coccothrinax argentata* (silver palm), *Guapira discolor* (blolly), *Drypetes diversifolia* (milkbark), *Genipa clusiifolia* (seven year apple), and *Metopium toxiferum* (poisonwood). Characteristic tall shrub and short tree species include *Eugenia foetida* (Spanish stopper), *Ximenia americana* (hog plum), *Randia aculeata* (white indigoberry), *Pithecellobium keyense* (Florida Keys blackbead), and *Sideroxylon celastrinum* (saffron plum). Short shrubs and herbs include *Hymenocallis latifolia* (perfumed spiderlily), *Capparis flexuosa* (bayleaf capertree), *Lantana involucrata* (buttonsage), and *Rivina humilis* (rougeplant). More seaward berms or those more recently affected by storm deposition may support a suite of plants similar to beaches, including shoreline *Sesuvium portulacastrum* (sea purslane), *Distichlis spicata* (saltgrass), and *Sporobolus virginicus* (seashore dropseed), or scattered to dense shrub thickets with *Conocarpus erectus* (buttonwood), stunted *Avicennia germinans* (black mangrove), *Rhizophora mangle* (red mangrove), *Laguncularia racemosa* (white mangrove), *Suriana maritima* (bay cedar), *Manilkara jaimiqui* (wild dilly), *Jacquinia keyensis* (joewood), and *Borrchia frutescens* (bushy seaside oxeye) (Florida Natural Areas Inventory (FNAI) 2010a, p. 1).

Coastal berms are deposited by storm waves along low-energy coasts. Their distance inland depends on the height of the storm surge. Tall berms may be the product of repeated storm deposition. Coastal berms that are deposited far enough inland and remain long-undisturbed may in time succeed to hammock. This is a structurally variable community that

may appear in various stages of succession following storm disturbance, from scattered herbaceous beach-colonizing plants to a dense stand of tall shrubs (FNAI 2010a, p. 2).

### Historical Range

All known historical and current records for *Dalea carthagenensis* var. *floridana* are summarized in table 4. The historical range of *D. carthagenensis* var. *floridana* includes Miami-Dade, Monroe, Collier, and Palm Beach Counties (Gann *et al.* 2015, pp. 25–26). There have been no reports of this plant from Palm Beach County since 1918 (Bradley and Gann 1999, p. 42). In Miami-Dade County, the species has been extirpated from a number of historical locations, including Castellow Hammock, ENP, the Coral Gables area, pinelands south of the Miami River, and Cox Hammock (Bradley and Gann 1999, pp. 42–43; Maschinski *et al.* 2014, p. 39). Gann *et al.* (2002, pp. 408–411) accounted for essentially every herbarium specimen and reliable sighting. Gann (2015, pp. 25–26) did not find *D. carthagenensis* var. *floridana* in ENP, and it is presumed to be extirpated at this location. One of the previous records at ENP was originally misidentified and has recently been confirmed as a specimen of *Aeschynomene pratensis* (J. Sadle, NPS, pers. comm. 2014). The other ENP herbarium specimen was correctly identified, but the plant is currently considered to be extirpated from the historical location (J. Sadle, NPS, pers. comm. 2014).

### Current Range, Population Estimates, and Status

The current range of *Dalea carthagenensis* var. *floridana* includes BCNP (Monroe and Collier Counties), three Miami-Dade County conservation areas, and three unprotected lands within the Cutler Bay region of Miami-Dade County (Maschinski *et al.* 2014, p. 39)

In 1999, *Dalea carthagenensis* var. *floridana* was rediscovered within BCNP (Bradley and Gann 1999, p. 42). Maschinski *et al.* (2014, p. 31) subsequently surveyed the four extant populations on BCNP, finding them at two locations. An area north of Oasis Visitor Center contained 236 plants (of various ages) and represents the largest extant population within BCNP. The second extant population was in the Pinecrest region (along Loop Road) of BCNP, an historic location within the Park; however, only 17 plants were encountered. The species was not found at 11-Mile Road, or at a second location along Loop Road during the surveys.

Maschinski *et al.* (2014, pp. 31–34) have extensively surveyed extant *Dalea carthagenensis* var. *floridana* populations at Charles Deering Estate, R. Hardy Matheson Preserve, and Crandon Park within Miami-Dade County over the past decade.

During 2003 to 2007, the population at Charles Deering Estate ranged from between 50 and 80 individuals, with the number of seedlings ranging from 3 to 54. However, beginning in 2008, Maschinski *et al.* (2014, p. 33) have documented pulses in seedling establishment. In 2010, the total population size (seedlings and woody plants) was 356 individuals. The majority of these were seedlings and basal re-sprouts from a fire that affected approximately one-third of the population (Maschinski *et al.* 2010, p. 24). A 2014 survey found 347 plants, suggesting the population remains stable (Maschinski *et al.* 2015, p. 30).

The population at R. Hardy Matheson Preserve had declined from 31 plants in 2004 to just 1 woody plant and 3 seedlings in 2008. However, the population increased to 330 and 200 seedlings in 2009 and 2010, respectively. The most recent surveys indicated stable populations of 98 and 307 individuals, in 2014 and 2015, respectively (Maschinski *et al.* 2010, p. 30; 2014, p. 34).

In 2003, *Dalea carthagenensis* var. *floridana* was discovered within coastal uplands at Crandon Park for the first time since 1966 (Maschinski *et al.* 2010, p. 28). The population at Crandon Park appears to be stable; however, it is highly localized to a small area of approximately 145 m<sup>2</sup> (Possley and Maschinski 2009, p. 10). During 2007, FTBG initiated a demographic study of the species. Sampling plots found 200 plants of various sizes, resulting in a population estimate of 966 plants at the site (J. Maschinski, pers. comm. 2007; Possley and Maschinski 2009, p. 10). Subsequent surveys have shown the population to vary considerably, possibly due to a short lifespan or plant dormancy (Possley and Maschinski 2009, p. 10). Surveys at Crandon Park identified 288 and 168 individuals, in 2014 and 2015, respectively (Maschinski *et al.* 2015, p. 32). Additional known populations within Miami-Dade County are summarized in table 4.

Table 4. Summary of the status and trends of the known occurrences of *Dalea carthagenensis* var. *floridana*.

<b>Population</b>	<b>Ownership</b>	<b>Most Recent Population Estimate</b>	<b>Status</b>	<b>Trend</b>
Everglades National Park	National Park Service	-	Extirpated (1964)	-
Big Cypress National Preserve, North of Oasis Visitor Center	National Park Service	236 (2013)	Extant	Insufficient data
Big Cypress National Preserve, 11-Mile Road	National Park Service	0 (2013)	Extirpated (2014)	Insufficient data
Big Cypress National Preserve, Pinecrest	National Park Service	17 (2013)	Extant	Insufficient data
Charles Deering Estate	Miami-Dade County	347 (2014)	Extant	Stable
Virginia Key (reintroduction)	City of Miami	4 (2010)	Extant	Insufficient data
R. Hardy Matheson	Miami-Dade	307 (2015)	Extant	Stable

Preserve	County			
Crandon Park	Miami-Dade County	168 (2015)	Extant	Stable
Strawberry Fields Hammock (next to Natural Forest Community)	Private	17 (2014)	Extant	Insufficient data
HRS, Inc.	Private	21 (2014)	Extant	Insufficient data
Florida Power and Light property	Florida Power and Light	2–10 (2007)	Extant	Insufficient data
Coral Gables area	Private	-	Extirpated (1967)	-
Cox Hammock	Private	-	Extirpated (1930)	-
Castellow Hammock Preserve	Miami-Dade County	-	Extirpated (1975)	-
Pineland South of Miami River	Unknown	Unknown	Unknown	-
Palm Beach County	Private	-	Extirpated (1918)	-

## Biology

### *Life History and Reproduction*

*Dalea carthagenensis* var. *floridana* appears to be a short-lived (less than 7 years) perennial with a persistent seed bank (Maschinski *et al.* 2014, p. 45). The species produces flowers from October to March, and fruit ripen from November to April. The seed maturation period is January to May, with a peak in February and March. Larger plants can produce more than 500 seeds. Seedling recruitment varies widely from year to year, with lower recruitment in drier years. Seedlings and juveniles experience rapid growth in their first 2 years (Maschinski *et al.* 2014, p. 45). The plants can stand partial inundation with fresh water for a portion of the year, but do not tolerate salinity.

Maschinski *et al.* (2014, p. 41) used ongoing survey data from the Crandon Park population to conduct a preliminary population viability analysis (PVA). The population at

Crandon Park declined by 33 percent from 2007 to 2009. High seedling recruitment increased numbers in 2010, which stabilized the population until 2014, when a pulse of high recruitment occurred. The demographic study indicated that 3 years had declining population growth and 4 years were stable or increasing, a cyclic pattern characteristic of short-lived species. The PVA indicated that the external cues (temperature and soil moisture) required to break dormancy positively influenced *Dalea carthagenensis* var. *floridana* population dynamics. However, if coupled with seedling mortality, serious population decline resulted. Low winter temperature coupled with average rainfall resulted in high seedling recruitment and good seedling survival; however, if high rainfall followed cold winter temperatures, as was noted for winter 2010, seedling mortality was high (Maschinski *et al.* 2014, p. 41).

#### *Fire Ecology and Demography*

There have been no studies of *Dalea carthagenensis* var. *floridana* relationship to fire; however, periodic fire is extremely important to maintaining habitat for this species (Maschinski *et al.* 2014, p. 47). Therefore, historical declines have been partially attributed to habitat loss from fire suppression or inadequate fire management.

#### **Summary of Biological Status and Threats**

The Act directs us to determine whether any species is an endangered species or a threatened species because of any factors affecting its continued existence. In this section, we summarize the biological condition of each of the plant species and its resources, and the influences on such, to assess the species' overall viability and the risks to that viability.



*Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range*

*Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* have experienced substantial destruction, modification, and curtailment of their habitat and range (see **Background**, above). Specific threats to these plants included in this factor include habitat loss, fragmentation, and modification caused by development (i.e., conversion to both urban and agricultural land uses) and inadequate fire management. Each of these threats and its specific effects on these plants are discussed in detail below.

Human Population Growth, Development, and Agricultural Conversion

The modification and destruction of the habitats that support *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* has been extreme in most areas of Miami-Dade and Monroe Counties, thereby reducing the plants' current range and abundance in Florida. The pine rockland community of south Florida, in which these species primarily occur, is critically imperiled locally and globally (FNAI 2010, p. 62). Destruction of pine rocklands and rockland hammocks has occurred since the beginning of the 1900s. Extensive land-clearing for human population growth, development, and agriculture in Miami-Dade and Monroe Counties has altered, degraded, or destroyed thousands of acres of these once-abundant ecosystems.

In Miami-Dade County, development and agriculture have reduced pine rockland habitat by 90 percent in mainland south Florida. Pine rockland habitat in Miami-Dade County, including ENP, was reduced to about 11 percent of its natural extent, from approximately 74,000

ha (183,000 ac) in the early 1900s, to only 8,140 ha (20,100 ac) in 1996 (Kernan and Bradley 1996, p. 2). The largest remaining intact pine rockland (approximately 2,313 ha (5,716 ac)) is Long Pine Key in ENP. Outside of ENP, only about 1 percent of the pine rocklands on the Miami Rock Ridge have escaped clearing, and much of what is left are small remnants scattered throughout the Miami metropolitan area, isolated from other natural areas (Herndon 1998, p. 1). Habitat loss continues to occur in these plants' range, and most remaining suitable habitat has been negatively altered through human activity (illegal clearing, dumping), preclusion of fire, and introduction of nonnative species.

Significant remaining pine rockland habitat occurs on private lands and publicly owned lands that are not dedicated to or managed for conservation. Species occurrences and suitable habitat remaining on these lands are threatened by habitat loss and degradation, and threats are expected to accelerate with increased development. The human population within Miami-Dade County is currently greater than 2.4 million people, and the population is expected to grow to more than 4 million by 2060, an annual increase of roughly 30,000 people (Zwick and Carr 2006, p. 20). Some of the known populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* occur on public conservation lands. Miami-Dade County has developed a network of publicly owned conservation lands within Miami-Dade County, but prescribed fire is lacking at many of these sites. ENP and BCNP actively manage their respective pine rockland habitat with prescribed fire (tables 1–4). However, any extant populations of these plants or suitable habitat that may occur on non-conservation public or private land, such as within the Richmond Pine Rocklands, are vulnerable to habitat loss directly from development or indirectly by lack of management.

The marl prairie habitat that also supports *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* has similarly been destroyed by the rapid development of Miami-Dade and Monroe Counties. At least some of the occurrences reported from this habitat may be the result of colonization that occurred after the habitat was artificially dried-out due to local or regional drainage. Marl prairie on non-conservation public or private land remains vulnerable to development, which could lead to the loss of populations of the species.

*Sideroxylon reclinatum* ssp. *austrofloridense* occurs in numerous pine rocklands outside of ENP within Miami-Dade County, most of which are impacted by some degree of development. Two privately owned sites in Miami-Dade County supporting *Sideroxylon reclinatum* ssp. *austrofloridense* are vulnerable to habitat loss from development. Eight sites that support the species are public land, which provides for some management and protection. However, one population on public land, the county-owned Nixon-Smilely Preserve, is extirpated due to inadequate management.

Both extant populations of *Digitaria pauciflora* are located at ENP and BCNP, which are public lands managed for conservation. However, *D. pauciflora* is extirpated from four sites outside ENP and BCNP, which comprise half of the species' historical range (Bradley and Gann 1999, p. 25; Gann 2015, p. 167). Outside the protected lands of ENP and BCNP, *Digitaria pauciflora* occurred throughout Miami-Dade County, including as recently as 1995 within the pine rockland and marl prairie habitats of the Martinez Pineland. Martinez Pineland is adjacent to several other remnant pine rocklands that form the largest contiguous area of pine rockland habitat in Miami-Dade County. However, *D. pauciflora* has since disappeared (Herndon 1998, p. 88; Bradley and Gann 1999, p. 49) from Martinez Pineland, and plans are being reviewed for

development of private portions (see discussion of Richmond Pine Rocklands, below). Gordon *et al.* (2007, pp. 1, 38) did not document other extant *D. pauciflora* populations during surveys to map rare and exotic plants along FDOT right-of-ways within Miami-Dade and Monroe Counties. Three other historical occurrences in Miami-Dade County had been documented; however, no population estimates were made prior to these areas being destroyed by habitat loss.

Eight populations of *Chamaesyce deltoidea* ssp. *pinetorum* located on private land are vulnerable to habitat loss due to development. Ten extant populations occur on public land and are largely protected from development. A historical population of *Chamaesyce deltoidea* ssp. *pinetorum* within Larry and Penny Thompson Park (also part of the Richmond Pine Rocklands) has been extirpated due to lack of prescribed fire (J. Possley, FTBG, pers. comm. 2011).

*Dalea carthagenensis* var. *floridana* has been extirpated from a number of historical locations within Miami-Dade County, including ENP for unknown reasons, and by development at Castellow Hammock, in the Coral Gables area, the pinelands south of the Miami River, and Cox Hammock (Bradley and Gann 1999, pp. 42–43; Maschinski *et al.* 2014, p. 39). In addition, there have been no reports of this species from Palm Beach County since 1918, and this area is now densely developed (Bradley and Gann 1999, p. 42). Six populations occur on public lands and are protected from development. Three extant populations occur on private land and are vulnerable to habitat loss from development.

Currently, there are plans to develop 55 ha (137 ac) of the largest remaining parcel of pine rockland habitat in Miami-Dade County, the Richmond Pine Rocklands, with a shopping center and residential construction (Ram 2014, p. 2). Bradley and Gann (1999, p. 4) called the 345-ha (853-ac) Richmond Pine Rocklands, “the largest and most important area of pine rockland in Miami-Dade County outside of Everglades National Park.” Although both *Digitaria*

*pauciflora* and *Chamaesyce deltoidea* ssp. *pinetorum* have been extirpated from Richmond Pine Rocklands, populations of *Sideroxylon reclinatum* ssp. *Austrofloridense*, along with numerous other federally listed species, still occur there.

The Miami-Dade County Department of Environmental Resources Management has completed a management plan for portions of the Richmond Pine Rocklands under a grant from the Service and is leading the restoration and management of the Richmond Pine Rocklands (Bradley and Gann 1999, p. 4). The developer has proposed to enter into a Habitat Conservation Plan in conjunction with their plans to develop their portion of the site and was required by Miami-Dade County Natural Forest Community (NFC) regulations to set aside and manage 17 ha (43 ac) of pine rockland and associated habitats. A second project that would result in the loss of pine rockland habitat has been proposed for the Richmond Pine Rocklands. It includes expanding the Miami Zoo complex to develop an amusement park and commercial entities. These development projects will result in the loss of pine rockland habitat that maintains a population of *Sideroxylon reclinatum* ssp. *austrofloridense* as well as several federally listed species, and may preclude future recovery options for the four plants (such as compromising the land managers ability to burn within Richmond Pine Rocklands).

#### Habitat Fragmentation

The remaining pine rocklands in the Miami metropolitan area are severely fragmented and isolated from each other. Habitat fragmentation reduces the size of plant populations, and increases spatial isolation of remnants. Barrios *et al.* (2011, p. 1062) investigated the effects of fragmentation on a threatened pine rockland plant, *Angadenia berteroi* (pineland golden trumpet), and found that abundance and fragment size were positively related. Possley *et al.*

(2008, p. 385) studied the effects of fragment size on species composition in south Florida pine rocklands, and found that plant species richness and fragment size were positively correlated (although some small fragments supported nearly as many species as the largest fragment). Composition of fragmented habitat typically differs from that of intact forests, as isolation and edge effects increase leading to increased abundance of disturbance-adapted species (weedy species, nonnative invasive species) and lower rates of pollination and propagule dispersal (Laurence and Bierregaard 1997, pp. 347–350.; Noss and Csuti 1997, pp. 284–299).

The degree to which fragmentation threatens the dispersal abilities of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* is unknown. In the historical landscape, where pine rockland occurred within a mosaic of wetlands, water may have acted as a dispersal vector for all pine rockland seeds. In the current fragmented landscape, this type of dispersal would no longer be possible for any of the Miami-Dade populations, because they exist in isolated habitat patches surrounded by miles of unsuitable habitat (agriculture and urban development) on every side. While additional dispersal vectors may include animals and (in certain locations) mowing equipment, it is likely that fragmentation has effectively reduced these plants' ability to disperse.

While pollination research has not been conducted for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*, research regarding other species and ecosystems provides valuable information regarding potential effects of fragmentation to these plants. Effects of fragmentation may include changes to the pollinator community as a result of limitation of pollinator-required resources (*e.g.*, reduced availability of rendezvous plants, nesting and roosting sites, and nectar/pollen); these changes may include changes to pollinator community composition, species

abundance and diversity, and pollinator behavior (Rathcke and Jules 1993, pp. 273–275; Kremen and Ricketts 2000, p. 1227; Harris and Johnson 2004, pp. 30–33). As a result, plants in fragmented habitats may experience lower visitation rates, which in turn may result in reduced seed production of the pollinated plant (which may lead to reduced seedling recruitment), reduced pollen dispersal, increased inbreeding, reduced genetic variability, and ultimately reduced population viability (Rathcke and Jules 1993, p. 275; Goverde *et al.* 2002, pp. 297–298; Harris and Johnson 2004, pp. 33–34).

The effects of fragmentation on fire go beyond edge effects and include reduced likelihood and extent of fires, and altered behavior and characteristics (*e.g.*, intensity) of those fires that do occur. Habitat fragmentation encourages the suppression of naturally occurring fires, and has prevented fire from moving across the landscape in a natural way, resulting in an increased amount of habitat suffering from these negative impacts. High fragmentation of small habitat patches within an urban matrix discourages the use of prescribed fire as well due to logistical difficulties (see Fire Management, below).

Forest fragments in urban settings are also subject to increased likelihood of certain types of human-related disturbance, such as the dumping of trash (Chavez and Tynon 2000, p. 405) and illegal clearing. The many effects of habitat fragmentation may work in concert to threaten the local persistence of a species, especially of small populations (see discussion below); when a species' range of occurrence is limited, as with these four plants, threats to local persistence increase extinction risk.

## Fire Management

One of the primary threats to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* is habitat modification and degradation through inadequate fire management, which includes both the lack of prescribed fire and suppression of natural fires. Where the term “fire-suppressed” is used below, it describes degraded pine rockland conditions resulting from a lack of adequate fire (natural or prescribed) in the landscape. Historically, frequent (approximately twice per decade), lightning-induced fires were a vital component in maintaining native vegetation and ecosystem functioning within south Florida pine rocklands (see Status Assessment, above). A period of just 10 years without fire may result in a marked decrease in the number of herbaceous species due to the effects of shading and litter accumulation (FNAI 2010, p. 63). Exclusion of fire for approximately 25 years will likely result in gradual hammock development over that time period, leaving a system that is very fire resistant if additional pre-fire management (*e.g.*, mechanical hardwood removal) is not undertaken.

Today, natural fires are unlikely to occur or are likely to be suppressed in the remaining, highly fragmented pine rockland habitat. The suppression of natural fires has reduced the size of the areas that burn, and habitat fragmentation has prevented fire from moving across the landscape in a natural way. Without fire, successional climax from pine rockland to rockland hammock takes 10 to 25 years, and displacement of native species by invasive nonnative plants often occurs. All occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are affected by some degree of inadequate fire management, with the primary threat being shading by hardwoods (Bradley and Gann 1999, p. 15; Bradley and Gann 2005, page numbers not applicable). Shading may also be caused by a fire-suppressed (and, in some cases, planted) pine



canopy that has evaded the natural thinning effects that fire has on seedlings and smaller trees. Gann (2013, pers. comm.) indicates this is also a threat to pine rockland habitat on the Miami Rock Ridge. Understory plants such as *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are shaded out after just 10 years without fire, by hardwoods and nonnatives alike.

Whether the dense canopy is composed of pine, hardwoods, nonnatives, or a combination, seed germination and establishment are inhibited in fire-suppressed habitat due to accumulated leaf litter, which also changes soil moisture and nutrient availability (Hiers *et al.* 2007, pp. 811–812). This alteration to microhabitat can also inhibit seedling establishment as well as negatively influence flower and fruit production (Wendelberger and Maschinski 2009, pp. 849–851), thereby reducing sexual reproduction in fire-adapted species such as *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* (Geiger 2002, pp. 78–79, 81–83).

After an extended period of inadequate fire management in pine rocklands, it becomes necessary to control invading native hardwoods mechanically, since excess growth of native hardwoods would result in a hot fire, which can cause mortality of pines and destroys the rootstocks and seed banks of other native plants. Mechanical treatments cannot entirely replace fire because pine trees, understory shrubs, grasses, and herbs all contribute to an ever-increasing layer of leaf litter, covering herbs and preventing germination, as discussed above. Leaf litter will continue to accumulate even if hardwoods are removed mechanically. In addition, the ashes left by fires provide important post-fire nutrient cycling, which is not provided via mechanical removal.

The impacts of fire on *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are not entirely understood. Fire is critical in maintaining the open understory and species diversity in pine rocklands and marl prairies where these species occur, as well as to reduce populations of nonnative plant species. Fire maintains the ecotone (transition) between saw grass marsh, pine rockland, and rockland hammock habitats where *S. reclinatum* ssp. *austrofloridense* grows.

Some natural mortality of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* may occur from fire, especially more intense fires. *S. reclinatum* ssp. *austrofloridense* and *C. deltoidea* ssp. *pinetorum* grow in wet marl soils and soil deposits within cracks in the limestone bedrock, which provides protection to the roots and allows plants to resprout following fire. *C. deltoidea* ssp. *pinetorum*, in particular, possesses a well-developed rootstock that is protected from fire (ENP 2014, p. 203). Herndon (1998, p. 28) pointed out that the life history of *C. deltoidea* ssp. *pinetorum* includes a cryptic stage, making interpretation of mortality of aboveground parts difficult.

Currently, limited information is available on differences in mortality or long-term population impacts of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, and *C. deltoidea* ssp. *pinetorum* in pine rocklands. Prescribed fire in ENP was originally conducted during the dry season. Fire management was gradually shifted to wet-season burning in an effort to better mimic natural lightning-ignited fire patterns. As a result, pinelands and marl prairies in ENP

where *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, and *C. deltoidea* ssp. *pinetorum* occur have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice will sustain populations of these species.

Federal (Service, NPS), State (Florida Department of Environmental Protection (FDEP), Florida Fish and Wildlife Conservation Commission (FWC), and County (Miami-Dade DERM) land managers, and nonprofit organizations (Institute for Regional Conservation (IRC)) implement prescribed fire on public and private lands within the ranges of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*. While management of some County conservation lands includes regular burning, other lands remain severely fire-suppressed. Even in areas under active management, some portions are typically fire-suppressed. Nevertheless, all of these sites retain a contingent of native species and a seedbank capable of responding to fire.

While ENP, BCNP, and various Miami-Dade County conservation lands (e.g., Navy Wells Pineland Preserve) each attempt to administer prescribed burns, the threat of inadequate fire management still remains. The pine rocklands in the Long Pine Key region of ENP remained largely fire-suppressed for the past decade as the Park updated its fire management plan. Although prescribed fire was returned to Long Pine Key in early 2016, many areas retained substantial amounts of unburned understory vegetation. As a result, despite reintroduction of a fire regime, several large-scale wildfires ignited during the spring months of 2016, which burned up to 50 percent of the pine rocklands in Long Pine Key. Ultimately, this combination of prescribed burns and natural fires (if not too hot or lasting too long) is likely to improve conditions for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* populations within ENP. For example, at 3 to 6 months

post-burn, these species appear to be recolonizing burned areas (Sadle, pers. comm. 2016; Salvato, pers. obs. 2016). However, this chain of events also demonstrated the threat that prolonged or insufficient fire management may pose to local populations of an imperiled species, even on public conservation lands.

Implementation of a prescribed fire program in Miami-Dade County has been hampered by a shortage of resources, and by logistical difficulties and public concern related to burning next to residential areas. Many homes have been built in a mosaic of pine rockland, so the use of prescribed fire in many places has become complicated because of potential danger to structures and smoke generated from the burns. Nonprofit organizations such as IRC have similar difficulties in conducting prescribed burns due to difficulties with permitting and obtaining the necessary permissions as well as hazard insurance limitations (Gann 2013, pers. comm.). Few private landowners have the means and/or desire to implement prescribed fire on their property, and doing so in a fragmented urban environment is logistically difficult and may be costly. One of the few privately owned pine rocklands that is successfully managed with prescribed burning is Pine Ridge Sanctuary, located in a more agricultural (less urban) matrix of Miami-Dade, which was last burned in November 2010 (Glancy 2013, pers. comm.) and retains populations of both *Sideroxylon reclinatum* ssp. *austrofloridense* and *Chamaesyce deltoidea* ssp. *pinetorum*. Similarly, extant populations of *Dalea carthagenensis* var. *floridana* within the privately owned Charles Deering Estate and County-owned Crandon Park, are managed with fire.

Conservation Efforts to Reduce the Present or Threatened Destruction, Modification, or  
Curtailement of Habitat or Range

*Miami-Dade County Environmentally Endangered Lands Covenant Program*

In 1979, Miami-Dade County enacted the Environmentally Endangered Lands (EEL) Covenant Program, which reduces taxes for private landowners of natural forest communities (NFCs; pine rocklands and tropical hardwood hammocks) who agree not to develop their property and manage it for a period of 10 years, with the option to renew for additional 10-year periods (Service 1999, p. 3-177). Although these temporary conservation easements provide valuable protection for their duration, they are not considered under Factor D, below, because they are voluntary agreements and not regulatory in nature. Miami-Dade County currently has approximately 59 pine rockland properties enrolled in this program, preserving 69.4 ha (172 ac) of pine rockland habitat (Johnson 2012, pers. comm.). The program also has approximately 21 rockland hammocks properties enrolled in this program, preserving 20.64 ha (51 ac) of rockland hammock habitat (Joyner 2013b, pers. comm.). The vast majority of these properties are small, and many are in need of habitat management such as prescribed fire and removal of nonnative invasive plants. Thus, while EEL covenant lands have the potential to provide valuable habitat for these plants and reduce threats in the near term, the actual effect of these conservation lands is largely determined by whether individual land owners follow prescribed EEL management plans and NFC regulations (see Local under Factor D).

#### *Fee Title Properties\*

In 1990, Miami-Dade County voters approved a 2-year property tax to fund the acquisition, protection, and maintenance of natural areas by the EEL Program. The EEL Program purchases and manages natural lands for preservation. Land uses deemed incompatible with the protection of the natural resources are prohibited by current regulations; however, the County Commission ultimately controls what may happen with any County property, and land use changes may occur over time (Gil 2013, pers. comm.). To date, the Miami-Dade County

EEL Program has acquired a total of approximately 313 ha (775 ac) of pine rockland, and 95 ha (236 ac) of rockland hammocks (Guerra 2015 pers. comm.; Gil 2013, pers. comm.). The EEL Program also manages approximately 314 ha (777 ac) of pine rocklands and 639 ha (1,578 ac) of rockland hammocks owned by the Miami-Dade County Parks, Recreation and Open Spaces Department, including some of the largest remaining areas of pine rockland habitat on the Miami Rock Ridge outside of ENP (*e.g.*, Larry and Penny Thompson Park, Zoo Miami pinelands, and Navy Wells Pineland Preserve), and some of the largest remaining areas of rockland hammocks (*e.g.*, Matheson Hammock Park, Castellow Hammock Park, and Deering Estate Park and Preserves).

Conservation efforts in Miami's EEL Preserves have been under way for many years. In Miami-Dade County, conservation lands are and have been monitored by FTBG and IRC, in coordination with the EEL Program, to assess habitat status and determine any changes that may pose a threat to or alter the abundance of these species. Impacts to habitat via nonnative species and natural stochastic events are monitored and actively managed in areas where the taxon is known to occur. These programs are long term and ongoing in Miami-Dade County; however, programs are limited by the availability of annual funding. In particular, fire management remains inadequate at many sites.

Since 2005, the Service has funded IRC to facilitate restoration and management of privately owned pine rockland habitats in Miami-Dade County. These programs included prescribed burns, nonnative plant control, light debris removal, hardwood management, reintroduction of pines where needed, and development of management plans. One of these programs, called the Pine Rockland Initiative, includes 10-year cooperative agreements between participating landowners and the Service/IRC to ensure restored areas will be managed

appropriately during that time. Although most of these objectives have been achieved, IRC has not been able to conduct the desired prescribed burns, due to logistical difficulties as discussed above (see Fire Management).

#### *Connect to Protect Program*

FTBG, with the support of various Federal, State, local, and nonprofit organizations, has established the “Connect to Protect Network.” The objective of this program is to encourage widespread participation of citizens to create corridors of healthy pine rocklands by planting stepping stone gardens and rights-of-way with native pine rockland species, and restoring isolated pine rockland fragments. By doing this, FTBG hopes to increase the probability that pollination and seed dispersal vectors can find and transport seeds and pollen across developed areas that separate pine rockland fragments to improve gene flow between fragmented plant populations and increase the likelihood that these plants will persist over the long term.

Although these projects may serve as valuable components toward the conservation of pine rockland species and habitat, they are dependent on continual funding, as well as participation from private landowners, both of which may vary through time.

#### *National Park Service Lands*

The NPS General Management Plans (GMPs) for ENP (NPS 2015) and BCNP (BCNP 2008) serve to protect, restore, and maintain natural and cultural resources at the ecosystem level. Although these GMPs are not regulatory, and their implementation is not mandatory, they do include conservation measures for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*.

#### Summary of Factor A

We have identified a number of threats to the habitat of the *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* that have operated in the past, are impacting these species now, and will continue to impact them in the future. Habitat loss, fragmentation, and degradation and associated pressures from increased human population are major threats; these threats are expected to continue, placing these plants at greater risk. *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* may be impacted when pine rocklands are converted to other uses or when lack of fire causes the conversion to hardwood hammocks or other unsuitable habitats.

On public lands, including Service, NPS, and Miami-Dade County-owned lands, implementation of prescribed fire has not been sufficient because of legal constraints (permitting requirements) and inadequate funding. Any populations of these four plants found on private property could be destroyed due to lack of protection. Although efforts are being made to conserve natural areas and apply prescribed fire, most pine rocklands remain in poor fire condition, and the long-term effects of large-scale and wide-ranging habitat modification, destruction, and curtailment will last into the future, while ongoing habitat loss due to population growth, development, and agricultural conversion continues to pose a threat to these species outside of conservation lands.

Therefore, based on the best information available, we have determined that the threats to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* from habitat destruction, modification, or curtailment are occurring throughout the entire range of these species and are expected to continue into the future.



*Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*

The best available data do not indicate that overutilization for commercial, recreational, scientific, or educational purposes are a threat to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*. Threats to these plants related to other aspects of recreation and similar human activities (i.e., not related to overutilization) are discussed in Factor E.

*Factor C. Disease or Predation*

No diseases or incidences of predation have been reported for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*.

*Factor D. The Inadequacy of Existing Regulatory Mechanisms*

Under this factor, we examine whether threats to these plants that are discussed under the other factors are continuing due to an inadequacy of an existing regulatory mechanism. Section 4(b)(1)(A) of the Act requires the Service to take into account “those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species....” In relation to Factor D, we interpret this language to require the Service to consider relevant Federal, State, and tribal laws, regulations, and other such mechanisms that may minimize any of the threats we describe in threat analyses under the other four factors, or otherwise enhance conservation of the species. We give strongest weight to statutes and their implementing regulations and to management direction that stems from those laws and

regulations. An example would be State governmental actions enforced under a State statute or constitution or Federal action under statute.

Having evaluated the impact of the threats as mitigated by any such conservation efforts, we analyze under Factor D the extent to which existing regulatory mechanisms address the specific threats to the species. Regulatory mechanisms, if they exist, may reduce or eliminate the impacts from one or more identified threats. In this section, we review existing Federal, State, and local regulatory mechanisms to determine whether they effectively reduce or remove threats to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*.

## Federal

Populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* within the Everglades and ENP and BCNP are protected by NPS regulations at 36 CFR 2.1, which prohibit visitors from harming or removing plants, listed or otherwise, from ENP or BCNP. However, the regulation does not address actions taken by NPS that cause mortality, or habitat loss or modification. NPS regulations do not require the application of prescribed fire or voluntary recovery actions for listed species.

In addition to occurring on ENP and BCNP, *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* may occur (we do not have recent surveys) on Federal lands within the Richmond Pine Rocklands, including lands owned by the U.S. Coast Guard and the National Oceanic and Atmospheric Association (NOAA; small portion of Martinez Pineland). There are

no Federal protections for candidate species, including these four plants, on these properties. Otherwise, these plants occur primarily on State, County, or private land (Tables 1–4), and development of these areas will likely require no Federal permit or other authorization. Therefore, projects that affect them are usually not analyzed under the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq.*).

## State

*Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are listed on the State of Florida's Regulated Plant Index as endangered under Chapter 5B-40, Florida Administrative Code. This listing provides little or no habitat protection beyond the State's Development of Regional Impact process, which discloses impacts from projects, but provides no regulatory protection for State-listed plants on private lands.

Florida Statutes 581.185 sections (3)(a) and (b) prohibit any person from willfully destroying or harvesting any species listed as endangered or threatened on the Index, or growing such a plant on the private land of another, or on any public land, without first obtaining the written permission of the landowner and a permit from the Florida Department of Plant Industry. The statute further provides that any person willfully destroying or harvesting; transporting, carrying, or conveying on any public road or highway; or selling or offering for sale any plant listed in the Index as endangered must have a permit from the State at all times when engaged in any such activities.

However, subsections (8)(a) and (b) of the statute waive State regulation for certain classes of activities for all species on the Regulated Plant Index, including the clearing or

removal of regulated plants for agricultural, forestry, mining, construction (residential, commercial, or infrastructure), and fire-control activities by a private landowner or his or her agent. On the other hand, section (10) of the statute provides for consultation similar to section 7 of the Federal Act for listed species by requiring the Department of Transportation to notify the FDACS and the Endangered Plant Advisory Council of planned highway construction at the time bids are first advertised, to facilitate evaluation of the project for listed plant populations, and to “provide for the appropriate disposal of such plants” (i.e., transplanting).

## Local

In 1984, Section 24–49 of the Code of Miami-Dade County established regulation of County-designated NFCs, which include both pine rocklands and tropical hardwood hammocks. These regulations were placed on specific properties throughout the county by an act of the Board of County Commissioners in an effort to protect environmentally sensitive forest lands. The Miami-Dade County Department of Regulatory and Economic Resources has regulatory authority over NFCs and is charged with enforcing regulations that provide partial protection on the Miami Rock Ridge. Miami-Dade Code typically allows up to 20 percent of a pine rockland designated as NFC to be developed, and requires that the remaining 80 percent be placed under a perpetual covenant. In certain circumstances, where the landowner can demonstrate that limiting development to 20 percent does not allow for “reasonable use” of the property, additional development may be approved. NFC landowners are also required to obtain an NFC permit for any work, including removal of nonnatives within the boundaries of the NFC on their property. The NFC program is responsible for ensuring that NFC permits are issued in accordance with the limitations and requirements of the code and that appropriate NFC preserves are established and

maintained in conjunction with the issuance of an NFC permit. The NFC program currently regulates approximately 600 pine rockland or pine rockland/hammock properties, comprising approximately 1,200 ha (3,000 ac) of habitat (Joyner 2013a, pers. comm.).

Although the NFC program is designed to protect rare and important upland (non-wetlands) habitats in south Florida, this regulatory strategy has limitations. For example, in certain circumstances where landowners can demonstrate that limiting development to 20 percent does not allow for “reasonable use” of the property, additional development may be approved. Furthermore, Miami-Dade County Code provides for up to 100 percent of the NFC to be developed on a parcel in limited circumstances for parcels less than 2.02 ha (5 ac) in size and requires coordination with the landowner only if the landowner plans to develop property or perform work within the NFC designated area. As such, the majority of the existing private forested NFC parcels consists of isolated fragments, without management obligations or preserve designation, as development has not been proposed at a level that would trigger the NFC regulatory requirements. Often, nonnative vegetation over time begins to dominate and degrade the undeveloped and unmanaged NFC landscape until it no longer meets the legal threshold of an NFC, which requires the land to be dominated by native vegetation. When development of such degraded NFCs is proposed, Miami-Dade County Code requires delisting of the degraded areas as part of the development process. Property previously designated as NFC is removed from the list even before development is initiated because of the abundance of nonnative species, making it no longer considered to be jurisdictional or subject to the NFC protection requirements of Miami-Dade County Code (Grossenbacher 2013, pers. comm.).

Summary of Factor D

Currently, *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are found on Federal, State, and County lands; however, there is no regulatory mechanism in place that provides substantive protection of actual habitat or of potentially suitable habitat at this time. NPS regulations provide some protection at ENP and BCNP sites, which protect the largest and best managed populations. State regulations provide protection against trade, but allow private landowners or their agents to clear or remove species on the Florida Regulated Plant Index. State Park regulations provide protection for plants within Florida State Parks. The NFC program in Miami is designed to protect rare and important upland (non-wetlands) habitats in south Florida; however, this regulatory strategy has several limitations (as described above) that reduce its ability to protect *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *D. carthagenensis* var. *floridana* and their habitats.

Although most populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are afforded some level of protection because they are on public conservation lands, existing regulatory mechanisms have not led to a sufficient reduction of threats posed to these plants by a wide array of sources (see discussions under Factors A and E).

#### *Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence*

Other natural or manmade factors affect *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* to varying degrees, including the spread of nonnative invasive plants, potentially incompatible management practices (such as mowing and herbicide use), direct impacts to plants

from recreation and other human activities, small population size and isolation, climate change, and the related risks from environmental stochasticity (extreme weather) on small populations. Each of these threats and its specific effect on these species are discussed in detail below.

### Nonnative Plant Species

Nonnative invasive plants compete with native plants for space, light, water, and nutrients, and make habitat conditions unsuitable for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*, which prefer open conditions. Bradley and Gann (1999, pp. 13, 71–72) indicated that the control of nonnative plants is one of the most important conservation actions for the four plants and a critical part of habitat maintenance.

Nonnative plants have significantly affected pine rocklands, and negatively impact all occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* to some degree (Bradley 2006, pp. 25–26; Bradley and Gann 1999, pp. 18–19; Bradley and Saha 2009, p. 25; Bradley and van der Heiden 2013, pp. 12–16). As a result of human activities, at least 277 taxa of nonnative plants have invaded pine rocklands throughout south Florida (Service 1999, p. 3-175). *Schinus terebinthifolius* (Brazilian pepper) and *Neyraudia neyraudiana* (Burma reed) affect these species (Bradley and Gann 1999, pp. 13, 72). Brazilian pepper, a nonnative tree, is the most widespread and one of the most invasive species. It forms dense thickets of tangled, woody stems that completely shade out and displace native vegetation (Loflin 1991, p. 19; Langeland and Craddock Burks 1998, p. 54). *Lygodium microphyllum* (Old World climbing fern) is also a serious threat throughout south Florida.

Nonnative plants in pine rocklands can also affect the characteristics of a fire when it does occur. Historically, pine rocklands had an open, low understory where natural fires remained patchy with low temperature intensity. *S. ssp. austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *D. carthagenensis* var. *floridana* thrive under this fire regime. However, dense infestations of *Neyraudia neyraudiana* and *Schinus terebinthifolius* cause higher fire temperatures and longer burning periods.

These nonnative species occur throughout the ranges of the four plants. In ENP and BCNP, invasives tend to be fewer due to the insularity of these sites and the NPS's control programs. Nevertheless, most areas require annual treatments to remove incipient invasions. Management of nonnative invasive plants in pine rocklands in Miami-Dade County is further complicated because the vast majority of pine rocklands are small, fragmented areas bordered by urban development. Areas near managed pine rockland that contain nonnative species can act as a seed source of nonnatives allowing them to continue to invade the surrounding pine rockland (Bradley and Gann 1999, p. 13).

Nonnative plant species are also a concern on private lands, where often they are not controlled due to associated costs, lack of interest, or lack of knowledge of detrimental impacts to the ecosystem. Undiscovered populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* on private lands could certainly be at risk. Overall, active management is necessary to control for nonnative species and to protect unique and rare habitats where these plants occur (Snyder *et al.* 1990, p. 273).

## Mowing



While no studies have investigated the effect of mowing on *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*, research has been conducted on the federally endangered *Linum carteri* var. *carteri* (which also occurs in pine rocklands). The study found significantly higher densities of plants at the mown sites where competition with other plants is decreased (Maschinski *et al.* 2007, p. 56). However, plants growing on mown sites were shorter, which may affect fruiting magnitude. While mowing did not usually kill adult plants, it could delay reproduction if it occurred prior to plants reaching reproductive status (Maschinski *et al.* 2007, pp. 56–57). If such mowing occurs repeatedly, reproduction of those plants would be entirely eliminated. Maschinski *et al.* (2008, p. 28) recommended adjusting the timing of mowing to occur at least 3 weeks after flowering is observed to allow a higher probability of adults setting fruit prior to the mowing event. With flexibility and proper instructions to land managers and ground crews, mowing practices could be implemented in such a way as to scatter seeds and reduce competition with little effect on population reproductive output for the year (Maschinski *et al.* 2008, p. 28). The exact impacts of mowing also depend on the timing of rainfall prior to and following mowing, and the numbers of plants in the population that have reached a reproductive state.

#### Recreation and Other Human Activities

Recreational use of off-road vehicles (ORV) is a threat to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Dalea carthagenensis* var. *floridana* occurrences within BCNP (K. Bradley *et al.* 2013, p. 3). Operators frequently veer off established trails, and plants can be harmed or destroyed (Bradley and Gann 1999, p. 43). BCNP manages ORV access

using a permit system, regulations, and designated trails. However, there are over 1,000 miles of ORV trails in BCNP, and only one enforcement officer (Pernas pers. comm., 2016), making enforcement of designated ORV trails a challenge. Current aerial imagery from the Lostman's Pine area of BCNP, where *Digitaria pauciflora* occurs, shows a criss-cross pattern of multiple ORV trails through the area. The Service is working with BCNP to determine the extent to which ORVs are affecting all three species at this site, particularly *D. pauciflora*, since it is one of only two sites where the species is known to exist. Damage from ORV use has also been documented for *Dalea carthagenensis* var. *floridana* within the Charles Deering Estate (J. Possley, pers. comm. 2008, 2009).

*Dalea carthagenensis* var. *floridana* at the R. Hardy Matheson Preserve is also impacted by illegal mountain biking (Bradley and Gann 1999, pp. 43–45). In the past, this pineland fragment was heavily used by mountain bikers. In response Miami-Dade County has erected fencing to protect this site, which appears to have reduced this threat (Bradley and Gann 1999, p. 43).

#### Effects of Small Population Size and Isolation

Endemic species whose populations exhibit a high degree of isolation are extremely susceptible to extinction from both random and nonrandom catastrophic natural or human-caused events. Species that are restricted to geographically limited areas are inherently more vulnerable to extinction than widespread species because of the increased risk of genetic bottlenecks, random demographic fluctuations, effects of climate change, and localized catastrophes such as hurricanes and disease outbreaks (Mangel and Tier 1994, p. 607; Pimm *et al.* 1988, p. 757). These problems are further magnified when populations are few and restricted to a very small

geographic area, and when the number of individuals is very small. Populations with these characteristics face an increased likelihood of stochastic extinction due to changes in demography, the environment, genetics, or other factors (Gilpin and Soule 1986, pp. 24–34).

Small, isolated populations, such as those in fragmented habitat, often exhibit reduced levels of genetic variability, although the ultimate effect of these changes is dependent on a plant's specific life history, reproductive system, and interaction with pollinators and dispersal vectors (which may themselves be affected by fragmentation) (Young *et al.* 1996, p. 413).

While research results clearly indicate that isolation/fragmentation has population genetic consequences for plants, consequences are varied and for some species there may be a “fragmentation threshold” below which genetic variation is not lost (Young *et al.* 1996, p. 416).

No such studies have been conducted for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*, so whether these plants exhibit such a threshold is not known.

Reduced genetic variability generally diminishes a species' capacity to adapt and respond to environmental changes, thereby decreasing the probability of long-term persistence (*e.g.*, Barrett and Kohn 1991, p. 4; Newman and Pilson 1997, p. 361). Very small plant populations may experience reduced reproductive vigor due to ineffective pollination or inbreeding depression. Isolated individuals have difficulty achieving natural pollen exchange, which limits the production of viable seed. The problems associated with small population size and vulnerability to random demographic fluctuations or natural catastrophes are further magnified by synergistic (interaction of two or more components) effects with other threats, such as those discussed above (Factors A and C). Tables 1, 2, 3, and 4 above list the population sizes and the geographic ranges for *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp.

*pinetorum*, and *D. carthagenensis* var. *floridana*. For example, table 2 lists *Digitaria pauciflora* as having 2 extant populations (ENP and BCNP), one estimated at 1,000–10,000 plants and the other with greater than 10,000 plants. The Service does not consider these as small populations; however, a large wildfire or severe flooding could be catastrophic. As shown in 2016, *D. pauciflora* was impacted by fire in ENP and flooding in ENP and BCNP, proving that the small geographic extent of the existing populations is not sufficient to eliminate the risk posed by large-scale disturbances.

### Effects of Climate Change

Climatic changes, including sea level rise (SLR), are major threats to the flora of south Florida, including *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*. Our analyses under the Act include consideration of ongoing and projected changes in climate. With regard to our analysis for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*, downscaled projections suggest that SLR is the largest climate-driven challenge to low-lying coastal areas in the subtropical ecoregion of southern Florida (U.S. Climate Change Science Program (USCCSP) 2008, pp. 5-31, 5-32).

The long-term record at Key West shows that sea level rose on average 0.229 cm (0.090 in) annually between 1913 and 2013 (NOAA 2013, p. 1). This equates to approximately 22.9 cm (9.02 in) over the last 100 years. IPCC (2008, p. 28) emphasized it is very likely that the average rate of SLR during the 21<sup>st</sup> century will exceed the historical rate. Heat trapped by greenhouse gases causes atmospheric warming, but the ocean is a vast heat sink where most of the increased

heat energy is stored. As the water increases in temperature, its volume expands. Due to the thermal dynamic properties of water, as projected temperatures increase, so does the volume of the ocean, and the rate of expansion. As a result, most models show a dramatic increase in the rate of SLR rise by mid-century. The IPCC Special Report on Emission Scenarios (2000, entire) presented a range of scenarios based on the computed amount of change in the climate system due to various potential amounts of anthropogenic greenhouse gases and aerosols in 2100. Each scenario describes a future world with varying levels of atmospheric pollution leading to corresponding levels of global warming and corresponding levels of SLR. The IPCC Synthesis Report (2007, entire) provided an integrated view of climate change and presented updated projections of future climate change and related impacts under different scenarios.

Subsequent to the 2007 IPCC Report, the scientific community has continued to model SLR. Recent peer-reviewed publications indicate a movement toward increased acceleration of SLR. Observed SLR rates are already trending along the higher end of the 2007 IPCC estimates, and it is now widely held that SLR will exceed the levels projected by the IPCC (Rahmstorf *et al.* 2012, p. 1; Grinsted *et al.* 2010, p. 470). Taken together, these studies support the use of higher end estimates now prevalent in the scientific literature. Recent studies have estimated global mean SLR of 1–2 m (3.3–6.6 ft) by 2100 as follows: 0.75–1.90 m (2.5–6.2 ft; Vermeer and Rahmstorf 2009, p. 21530), 0.8–2.0 m (2.6–6.6 ft; Pfeffer *et al.* 2008, p. 1342), 0.9–1.3 m (3.0–4.3 ft; Grinsted *et al.* 2010, pp. 469–470), 0.6–1.6 m (2.0–5.2 ft; Jevrejeva *et al.* 2010, p. 4), and 0.5–1.40 m (1.6–4.6 ft; National Resource Council 2012, p. 2).

Other processes expected to be affected by projected warming include temperatures, rainfall (amount, seasonal timing, and distribution), and storms (frequency and intensity) (discussed more specifically under Environmental Stochasticity, below). The Massachusetts

Institute of Technology (MIT) modeled several scenarios combining various levels of SLR, temperature change, and precipitation differences with human population growth, policy assumptions, and conservation funding changes (see Alternative Future Landscape Models, below). All of the scenarios, from small climate change shifts to major changes, indicate significant effects on coastal Miami-Dade County.

Decades prior to inundation, pine rocklands are likely to undergo vegetation shifts related to climate change, triggered by changes to hydrology (wetter), salinity (higher) and increasing vulnerability to storm surge (pulse events causing massive erosion and salinization of soils) (Saha *et al.* 2011, p. 82). Hydrology has a strong influence on plant distribution in these and other coastal areas (IPCC 2008, p. 57). Such communities typically grade from saltwater to brackish to freshwater species. From the 1930s to 1950s, increased salinity of coastal waters contributed to the decline of cabbage palm forests in southwest Florida (Williams *et al.* 1999, pp. 2056–2059), expansion of mangroves into adjacent marshes in the Everglades (Ross *et al.* 2000, pp. 101, 111), and loss of pine rockland in the Keys (Ross *et al.* 1994, pp. 144, 151–155). In one Florida Keys pine rockland with an average elevation of 0.89 m (2.9 ft), Ross *et al.* (1994, pp. 149–152) observed an approximately 65 percent reduction in an area occupied by South Florida slash pine over a 70-year period, with pine mortality and subsequent increased proportions of halophytic (salt-loving) plants occurring earlier at the lower elevations. During this same time span, local sea level had risen by 15 cm (6.0 in), and Ross *et al.* (1994, p. 152) found evidence of groundwater and soil water salinization.

Extrapolating this situation to pine rocklands on the mainland is not straightforward, but indications are that similar changes to species composition could arise if current projections of SLR occur and freshwater inputs are not sufficient to prevent salinization. Furthermore, Ross *et*

*al.* (2009, pp. 471–478) suggested that interactions between SLR and pulse disturbances (e.g., storm surges) can cause vegetation to change sooner than projected based on sea level alone. Alexander (1953, pp. 133–138) attributed the demise of pinelands on northern Key Largo to salinization of the groundwater in response to SLR. Patterns of human development will also likely be significant factors influencing whether natural communities can move and persist (IPCC 2008, p. 57; USCCSP 2008, p. 7-6).

The Science and Technology Committee of the Miami-Dade County Climate Change Task Force (Wanless *et al.* 2008, p. 1) recognized that significant SLR is a very real threat to the near future for Miami-Dade County. In a January 2008 statement, the committee warned that sea level is expected to rise at least 0.9–1.5 m (3–5 ft) within this century (Wanless *et al.* 2008, p. 3). With a 0.9–1.2 m (3–4 ft) rise in sea level (above baseline) in Miami-Dade County, spring high tides would be at about 6 to 7 ft; freshwater resources would be gone; the Everglades would be inundated on the west side of Miami-Dade County; the barrier islands would be largely inundated; storm surges would be devastating; landfill sites would be exposed to erosion contaminating marine and coastal environments. Freshwater and coastal mangrove wetlands will not keep up with or offset SLR of 2 ft per century or greater. With a 5-ft rise (spring tides at nearly +8 ft), the land area of Miami-Dade County will be extremely diminished (Wanless *et al.* 2008, pp. 3–4).

Drier conditions and increased variability in precipitation associated with climate change are expected to hamper successful regeneration of forests and cause shifts in vegetation types through time (Wear and Greis 2012, p. 39). Although this issue has not been well studied, existing pine rocklands have probably been affected by reductions in the mean water table. Climate changes are also forecasted to extend fire seasons and the frequency of large fire events

throughout the Coastal Plain (Wear and Greis 2012, p. 43). These factors will likely cause an increase in wildfires and exacerbate complications related to prescribed burning (i.e., less predictability related to rainfall, fuel moisture, and winds) or other management needed to restore and maintain habitat for the four plants. While restoring fire to pine rocklands is essential to the long-term viability of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* populations, increases in the scale, frequency, or severity of wildfires could have negative effects on these plants considering their general vulnerability due to small population size, restricted range, few occurrences, and relative isolation. Big, hot wildfires can destroy essential habitat features of pine rockland habitat. In addition, hot burns with long residence times (which are more likely under wildfire conditions) can also sterilize the soil seed bank and cause a demographic crash in plant populations.

#### Alternative Future Landscape Models

To accommodate the large uncertainty in SLR projections, researchers must estimate effects from a range of scenarios. Various model scenarios developed at MIT and GeoAdaptive Inc. have projected possible trajectories of future transformation of the south Florida landscape by 2060 based upon four main drivers: climate change, shifts in planning approaches and regulations, human population change, and variations in financial resources for conservation. The scenarios do not account for temperature, precipitation, or species habitat shifts due to climate change, and no storm surge effects are considered. The current MIT scenarios range from an SLR of 0.09–1.0 m (0.3–3.3 ft) by 2060 (Vargas-Moreno and Flaxman 2010, pp. 1–6).

Based on the most recent estimates of anticipated SLR, the upward trend in recent



projections toward the higher range of earlier SLR estimates (discussed above), and the data available to us at this time, we evaluated potential effects of SLR using the current “high” range MIT scenario as well as comparing elevations of remaining pine rockland fragments and extant and historical occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*. The “high” range (or “worst case”) MIT scenario assumes high SLR (1 m (3.3 ft) by 2060), low financial resources, a “business as usual” approach to planning, and a doubling of human population.

The rate of SLR will increase as time passes. This is due to atmospheric and ocean warming and the thermal expansion properties of water. In SLR models the rate of sea level rise is projected to increase dramatically around mid-century.

Most populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* occur at elevations less than 2 m (6.6 ft) above sea level, making these species highly susceptible to increased storm surges and related impacts associated with SLR. Areas of the Miami Rock Ridge in Miami-Dade County (located to the east of ENP and BCNP) are higher elevation (maximum of 7 m [22 ft] above sea level) than those in BCNP (FNAI 2010, p. 62). However, plant communities along South Florida’s low-lying coasts are organized along a mild gradient in elevation, transitioning from mangroves at sea level to salinity-intolerant interior habitats, including pine rocklands and hardwood hammocks within an elevation change of 2 m (6.5 ft) above sea level. As a result, a rise of 1 m (3.3 ft) in sea level is expected to render coastal systems susceptible to increased erosion and cause these areas to transition from upland forest habitats to saline wetland habitats.

Prior to the onset of sustained inundation, there will be irreversible changes in vegetation composition within these habitats. Shifts in habitat toward hydric and saline ecosystems may

occur decades in advance of full inundation, rendering the habitat unsuitable for salt-intolerant species including *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *D. carthagenensis* var. *floridana* (Saha *et al.* 2011, p. 82). As interior habitats become more saline there will be a reduction in freshwater inflows to the estuarine portions of ENP and BCNP, accelerating losses in salinity-intolerant coastal plant communities (Saha *et al.* 2011, p. 105), such as *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, or *D. carthagenensis* var. *floridana*.

Actual impacts may be greater or less than anticipated based upon the high variability of factors involved (*e.g.*, SLR, human population growth) and assumptions made, but based on the current “high” range MIT scenario, pine rocklands, marl prairies and associated habitats along the coast in central and southern Miami-Dade County would become inundated. The “new” sea level would occur at the southern end of the Miami Rock Ridge (the eastern edge of the Everglades). However, in decades prior to the fully anticipated sea level rise, changes in the water table and increased soil salinity from partial inundation and storm surge will result in vegetation shifts within BCNP, ENP, and conservation lands on the southern Miami Rock Ridge. Inundation will result in pine rocklands gaining increased marl prairie characteristics. Marl prairies, in turn, will transition to sawgrass or more hydric conditions, due to increased inundation.

As a result, species such as *Digitaria pauciflora* and *Sideroxylon reclinatum* ssp. *austrofloridense*, which are most abundant within the ecotone between pine rocklands and marl prairies, will gradually decline as these habitat types merge and eventually disappear. Under this scenario, by 2060, all extant populations of *Digitaria pauciflora*, as well as the largest populations of *Sideroxylon reclinatum* ssp. *austrofloridense* and *Dalea carthagenensis* var.

*floridana*, would likely be lost or significantly impacted by shifts in vegetation communities. Populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* would likely remain only at the highest elevations along the Miami Rock Ridge. In addition, many existing pine rockland fragments are projected to be developed for housing as the human population grows and adjusts to changing sea levels under this scenario.

#### Further or Additional Impacts Expected Beyond 2060

Further direct losses to extant populations of all four plants are expected due to habitat loss and modification from SLR through 2100. We analyzed existing sites that support populations of the four plants using the National Oceanic and Atmospheric Administration (NOAA) Sea Level Rise and Coastal Impacts viewer. Below we discuss general implications of sea level rise within the range of projections discussed above on the current distribution of these species. The NOAA tool uses 1-foot increments. Our analysis is based on 0.91 m (3 ft) and 1.8 m (6 ft) of SLR.

Based on a higher SLR of 1.8 m (6 ft), as projected by NOAA, much larger portions of urban Miami-Dade County, including conservation areas, such as Navy Wells Pineland Preserve, will be inundated by 2100. Under such a 1.8-meter SLR projection, both extant populations of *D. pauciflora* in ENP and BCNP would be almost entirely inundated by 2100, and the species will be extinct. Several extant occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* would also be lost. The western part of urban Miami-Dade County would also be inundated (barring creation of sea walls or other barriers), creating a virtual island of the Miami Rock Ridge.

Following a 1.8-m (6-ft) rise in sea level, approximately 75 percent of presently extant pine rocklands on the Miami Rock Ridge would still remain above sea level. However, an unknown percentage of remaining pine rockland fragments would be negatively impacted by water table and soil salinization, which would be further exacerbated due to isolation from mainland fresh water flows.

Projections of SLR above 1.8 m (6 ft) indicate that very little pine rockland would remain, with the vast majority either being inundated or experiencing vegetation shifts, resulting in the extirpation of all known populations of *Digitaria pauciflora*, *Sideroxylon reclinatum* ssp. *austrofloridense*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*.

#### Environmental Stochasticity

Endemic species whose populations exhibit a high degree of isolation and narrow geographic distribution, such as *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*, are extremely susceptible to extinction from both random and nonrandom catastrophic natural or human-caused events. Small populations of species, without positive growth rates, are considered to have a high extinction risk from site-specific demographic and environmental stochasticity (Lande 1993, pp. 911–927).

The climate of southern Florida is driven by a combination of local, regional, and global events, regimes, and oscillations. There are three main “seasons”: (1) the wet season, which is hot, rainy, and humid from June through October; (2) the official hurricane season that extends one month beyond the wet season (June 1 through November 30), with peak season being

August and September; and (3) the dry season, which is drier and cooler, from November through May. In the dry season, periodic surges of cool and dry continental air masses influence the weather with short-duration rain events followed by long periods of dry weather.

Florida is considered the most vulnerable State in the United States to hurricanes and tropical storms (Florida Climate Center, [http://coaps.fsu.edu/climate\\_center](http://coaps.fsu.edu/climate_center)). Based on data gathered from 1856 to 2008, Klotzbach and Gray (2009, p. 28) calculated the climatological probabilities for each State being impacted by a hurricane or major hurricane in all years over the 152-year timespan. Of the coastal States analyzed, Florida had the highest climatological probabilities, with a 51 percent probability of a hurricane (Category 1 or 2) and a 21 percent probability of a major hurricane (Category 3 or higher). From 1856 to 2015, Florida actually experienced 109 hurricanes and 36 major hurricanes. While not every hurricane will pass over south Florida, given the low population sizes and restricted ranges of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* within locations prone to storm influences, these species are at substantial risk from hurricanes, storm surges, and other extreme weather. Depending on the location and intensity of a hurricane or other severe weather event, it is possible that the plants could become extirpated or extinct.

Hurricanes, storm surge, and extreme high tide events are natural events that can negatively impact these four plants. Hurricanes and tropical storms can modify habitat (e.g., through storm surge) and have the potential to destroy entire populations, physically washing them away or leaving soil too saline for them to persist. Climate change may lead to increased frequency and duration of severe storms (Golladay *et al.* 2004, p. 504; McLaughlin *et al.* 2002, p. 6074; Cook *et al.* 2004, p. 1015). *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria*

*pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*

experienced these disturbances historically, but had the benefit of more abundant and contiguous habitat to buffer them from extirpations. With most of the historical habitat having been destroyed or modified, the few remaining populations of these species could face local extirpations due to stochastic events.

Other processes to be affected by climate change, related to environmental stochasticity, include temperatures, rainfall (amount, seasonal timing, and distribution), and storms (frequency and intensity). Temperatures are projected to rise from 2–5 °C (3.6–9 °F) for North America by the end of this century (IPCC 2007, pp. 7–9, 13). These factors will likely cause an increase in wildfires and exacerbate complications related to prescribed burning or other management needed to restore and maintain habitat for the four plants. Based upon modeling, Atlantic hurricane and tropical storm frequencies are expected to decrease (Knutson *et al.* 2008, pp. 1–21). By 2100, there should be a 10–30 percent decrease in hurricane frequency. Hurricane frequency is expected to drop due to more wind shear impeding initial hurricane development. However, hurricane winds are expected to increase by 5–10 percent, which will increase storm surge heights. This is due to more hurricane energy being available for intense hurricanes. In addition to climate change, weather variables are extremely influenced by other natural cycles, such as El Niño Southern Oscillation with a frequency of every 4–7 years, solar cycle (every 11 years), and the Atlantic Multi-decadal Oscillation. All of these cycles influence changes in Floridian weather. The exact magnitude, direction, and distribution of all of these changes at the regional level are difficult to project.

#### Freezing Temperatures

Occasional freezing temperatures that occur in south Florida pose a risk to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*, causing damage or death to individual plants. Under normal circumstances, occasional freezing temperatures would not result in a significant impact to populations of these plants; however, the small size of some populations means the loss from freezing events of even a few individuals can reduce the viability of the population.

### Hydrology and Everglades Restoration

Hydrology is a key ecosystem component that affects rare plant distributions and their viability (Gann *et al.* 2006, p. 4). Historically, sheet flow from Shark River Slough and Taylor Slough did not reach the upland portions of Long Pine Key, but during the wet season increased surface water flow in sloughs generated a rise in ground water across the region (Gann *et al.* 2006, p. 4). Water flow through Long Pine Key was originally concentrated in marl prairies, traversing in a north-south direction; however, construction of the main ENP road dissected Long Pine Key in an east-west direction, thereby impeding sheet flow across this area (Gann *et al.* 2006, p. 4). Water was either impounded to the north of the main ENP road or diverted around the southern portion of Long Pine Key through Taylor Slough and Shark River Slough (Gann *et al.* 2006, p. 4). As artificial drainage became more widespread, however, regional groundwater supplies declined.

While projects designed to restore the historical hydrology of the Everglades and other natural systems in southern Florida, including ENP and BCNP (collectively known as the Comprehensive Everglades Restoration Plan (CERP)), are beneficial to the Everglades ecosystem, some may produce collateral impacts to extant pine rockland, marl prairies, and

associated habitats within the region through inundation or increased hydroperiods. The effects of changes in regional hydrology through restoration may have impacts on the four plant species and their habitats. Sadle (2012, pers. comm.) suggested various CERP projects (such as C-111 spreader canal; L-31N seepage barrier), specifically the operation of pumps and associated detention areas along the ENP boundary, may influence (through excessive water discharges) select portions of eastern Long Pine Key. Increased and longer-duration hydroperiods within the pine rockland and marl prairie habitats where these species occur may lead to a reduction in the amount of suitable habitat, a potential reduction in the area occupied and a reduction in the number of individuals found in ENP and BCNP. It is unclear to what extent this may occur, if at all. In an effort to establish a baseline assessment of future hydrologic modifications, long-term monitoring transects and plots for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* were established in Long Pine Key between 2003 and 2008 (Gann 2015, p. 169).

#### Conservation Efforts To Reduce Other Natural or Manmade Factors Affecting Continued Existence

NPS, the Service, Miami-Dade County, and the State of Florida have ongoing nonnative plant management programs to reduce threats on public lands, as funding and resources allow. In Miami-Dade County, nonnative, invasive plant management is very active, with a goal to treat all publicly owned properties at least once a year and more often in many cases. IRC and FTBG conduct research and monitoring in various natural areas within Miami-Dade County and the Florida Keys for various endangered plant species and nonnative, invasive species. For the four plants, monitoring detects declines that lead to small population size, changes in habitat due to



SLR, and declines due to stochastic events. For nonnatives, monitoring is an integral part of efforts to detect and control invasive plant and animal species.

#### Summary of Factor E

We have discussed threats from other natural or manmade factors including: nonnative invasive plants, management practices (such as mowing and herbicide use), recreation (including ORV use), effects from small population size and isolation, limited geographic range, and stochastic events including hurricanes, storm surges, and wildfires. Additionally, these plants are particularly vulnerable to the effects of climate change, including SLR, as changes in the water table, increased soil salinity from partial inundation, and storm surge will likely result in vegetation shifts in the decades prior to the fully anticipated sea level rise. Some of these threats (e.g., nonnative species) may be reduced on public lands due to active programs by Federal, State, and County land managers. Many of the remaining populations of these plants are small and geographically isolated, and genetic variability is likely low, increasing the inherent risk due to overall low resilience of these plants. The threats act together to impact populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*.

#### Cumulative Effects of Threats

When two or more threats affect populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*, the effects of those threats could interact or become compounded, producing a cumulative adverse effect that is greater than the impact of either threat alone. The

most obvious cases in which cumulative adverse effects would be significant are those in which small populations (Factor E) are affected by threats that result in destruction or modification of habitat (Factor A), ORV damage (Factor E), or stochastic events, such as hurricanes, storm surges, wildfires (Factor E). The limited distributions and/or small population sizes of many populations of *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *D. carthagenensis* var. *floridana* make them extremely susceptible to the detrimental effects of further habitat modification, degradation, and loss, as well as other anthropogenic threats. Mechanisms leading to the decline of *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *D. carthagenensis* var. *floridana*, as discussed above, range from local (e.g., agriculture) to regional (e.g., development, fragmentation, nonnative species) to global influences (e.g., effects of climate change, SLR). The synergistic effects of threats, such as impacts from hurricanes on a species with a limited distribution and small populations, make it difficult to predict population viability. While these stressors may act in isolation, it is more probable that many stressors are acting simultaneously (or in combination) on populations of *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *D. carthagenensis* var. *floridana*, making them more vulnerable.

### **Proposed Determination**

We have carefully assessed the best scientific and commercial data available regarding the past, present, and future threats to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*.

*Sideroxylon reclinatum* ssp. *austrofloridense*

Nine of 11 extant populations are located on publicly owned conservation lands. This includes 10,000–100,000 plants at ENP, and a small population at BCNP, where prescribed fire implementation has improved, and nonnative plant control efforts are adequate to beneficially manage habitat for native species. In contrast, in the scattered small populations on Miami-Dade habitat fragments, representing half of the species' historical range, habitat management currently is not adequate due to the inability to conduct prescribed fire. Increasing temperatures and changes in precipitation patterns associated with climate change will likely cause an increase in wildfires and exacerbate complications related to prescribed burning or other management needed to restore and maintain habitat for the species. In the current, fragmented landscape, dispersal and genetic exchange for any of these smaller Miami-Dade populations is unlikely, because they exist in isolated habitat patches surrounded by miles of unsuitable habitat (agriculture and urban development). Two privately owned sites in Miami supporting extant populations are vulnerable to development. The largest populations (ENP and BCNP) are vulnerable to hydrologic changes related to Everglades restoration projects and SLR.

SLR projections suggest future inundation and modification to the majority of *Sideroxylon reclinatum* ssp. *austrorfloridense* habitat in ENP and BCNP by 2060. Decades prior to inundation, however, pine rocklands, marl prairies, and associated habitats within ENP and BCNP will undergo habitat transitions toward wetter, salt-tolerant plant communities, hydrological changes, and increasing vulnerability to storm surge. Although the effects of SLR within urban Miami-Dade fragments may be less severe, these pine rocklands will, at a minimum, experience partial inundations and vegetation shifts. In addition, many existing Miami-Dade pine rockland fragments are projected to be developed for housing as the human population grows and adjusts to changing sea levels under this scenario.

### *Digitaria pauciflora*

Only two of five historical *Digitaria pauciflora* locations are extant. They are located in BCNP (>10,000 plants) and ENP (1,000–10,000 plants) on publicly owned conservation lands where habitat management (prescribed fire and nonnative plant control) is ongoing and includes addressing a backlog of long-unburned sites that could result in larger wildfires if burns are not implemented. In addition, although we do not have evidence of direct impacts, given the mapped overlap of ORV trails with *Digitaria pauciflora* locations, ORV use in BCNP has likely resulted in damage to *Digitaria pauciflora* plants and habitat. The scattered small populations that once occurred in Miami-Dade habitat fragments, representing the remainder of the species' historical range, are extirpated, and current habitat management does not allow for prescribed fire to be conducted on a consistent basis. Increasing temperatures and changes in precipitation patterns associated with climate change will likely cause an increase in wildfires and exacerbate complications related to prescribed burning or other management needed to restore and maintain habitat for the species.

*Digitaria pauciflora* previously occurred within the Richmond Pine Rocklands, an area that retains the largest remaining contiguous privately and publicly owned pine rocklands in Miami-Dade County, outside of ENP. In terms of restoring the species' historical range, the Richmond Pine Rocklands would serve as one of the most important sites in Miami-Dade County for recovery efforts (i.e., reintroduction). The largest populations (ENP and BCNP) are vulnerable to hydrological changes related to Everglades restoration projects and SLR.

SLR projections suggest future partial inundation and modification to the majority of *D. pauciflora* habitat by 2060. Decades prior to inundation, however, pine rocklands, marl prairies,

and associated habitats within ENP and BCNP will undergo habitat transitions toward wetter, salt-tolerant plant communities, hydrological changes, and increase in vulnerability to storm surge. Although the effects of SLR within urban Miami-Dade fragments may be less severe, these pine rocklands will, at a minimum, experience partial inundations and vegetation shifts. In addition, many existing Miami-Dade pine rockland fragments are projected to be developed for housing as the human population grows and adjusts to changing sea levels under this scenario.

*Chamaesyce deltoidea* ssp. *pinetorum*

Eleven of 20 extant populations are located on publicly owned conservation lands. This includes 10,000–100,000 plants at ENP and 1,000 plants at Navy Wells pineland, where habitat management (prescribed fire and nonnative plant control) is ongoing, and includes addressing a backlog of long-unburned sites that could result in larger wildfires if burns are not implemented. In contrast, in the scattered small populations on Miami-Dade habitat fragments, representing half of the species' historical range, current habitat management does not allow for prescribed fire to be conducted on a consistent basis. Increasing temperatures and changes in precipitation patterns associated with climate change will likely cause an increase in wildfires and exacerbate complications related to prescribed burning or other management needed to restore and maintain habitat for the species. In the current, fragmented landscape, dispersal and genetic exchange for any of these smaller Miami-Dade populations is unlikely, because they exist in isolated habitat patches surrounded by miles of unsuitable habitat (agriculture and urban development). Eight privately owned sites in Miami supporting extant populations are vulnerable to development, two of which support 1,000–10,000 plants each. The largest population (Long Pine Key, ENP) is vulnerable to hydrological changes related to Everglades restoration projects and SLR.

SLR projections suggest future inundation and modification to the majority of *Chamaesyce deltoidea* spp. *pinetorum* habitat by 2060. Decades prior to inundation, however, pine rocklands, marl prairies, and associated habitats within ENP and BCNP will undergo habitat transitions toward wetter, salt-tolerant plant communities, hydrological changes, and increasing vulnerability to storm surge. Although the effects of SLR within urban Miami-Dade fragments may be less severe, these pine rocklands will, at a minimum, experience partial inundations and vegetation shifts. In addition, many existing Miami-Dade pine rockland fragments are projected to be developed for housing as the human population grows and adjusts to changing sea levels under this scenario.

*Dalea carthagenensis* var. *floridana*

Six of 9 extant populations are located on publicly owned conservation lands. This total includes 253 plants at BCNP (Monroe County), where prescribed fire and nonnative plant control efforts are adequate to beneficially manage habitat for native species. The two other largest populations occur in Miami-Dade County and consist of 347 plants at Charles Deering Estate, and 307 plants at R. Hardy Matheson Preserve, where current habitat management does not allow for prescribed fire to be conducted on a consistent basis. Higher temperatures and changes in precipitation patterns associated with climate change will likely cause an increase in wildfires and exacerbate complications related to prescribed burning or other management needed to restore and maintain habitat for the species. In the current, fragmented landscape, dispersal and genetic exchange between Miami-Dade populations is unlikely, because they exist in isolated habitat patches surrounded by miles of unsuitable habitat (agriculture and urban development). Three privately owned sites in Miami supporting extant populations are

vulnerable to development, two of which support 17 and 21 plants each. The population within BCNP is vulnerable to hydrological changes related to Everglades restoration projects and SLR.

Numerous populations of all plants have been extirpated from these species' historical ranges, and the primary threats of habitat destruction and modification resulting from human population growth and development, agricultural conversion, and inadequate fire management (Factor A); competition from nonnative, invasive species (Factor E); changes in climatic conditions, including SLR and changes in hydrology (Factor E); and natural stochastic events, including hurricanes, storm surges, and wildfires (Factor E) are threats for the existing populations. Existing regulatory mechanisms have not reduced or removed threats impacting the four plants from the other factors (see Factor D discussion). These threats are ongoing, rangewide, and expected to continue in the future. A significant percentage of populations of the four plants are relatively small and isolated from one another, and their ability to recolonize suitable habitat is unlikely without human intervention, if at all. The threats have had and will continue to have substantial adverse effects on *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* and their habitats. Although attempts are ongoing to alleviate or minimize some of these threats at certain locations, all populations appear to be impacted by one or more threats.

The Act defines an endangered species as “any species which is in danger of extinction throughout all or a significant portion of its range” and a threatened species as “any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.” We find that *Dalea carthagenensis* var. *floridana* is presently in danger of extinction throughout its entire range due to the immediacy and severity of threats currently impacting the species. The risk of extinction is high because there are few (9) extant

populations and the majority of the populations are small and isolated, and have limited to no potential for recolonization. Therefore, on the basis of the best available scientific and commercial information, we propose to list *Dalea carthagenensis* var. *floridana* as an endangered species in accordance with sections 3(6) and 4(a)(1) of the Act. We find that a threatened species status is not appropriate for this species because of the contracted range and small population size of *Dalea carthagenensis* var. *floridana* and because of the current magnitude and severity of the threats on the plant. Because the species is already in danger of extinction throughout its range, a threatened species status is not appropriate.

*Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* face threats similar to *Dalea carthagenensis* var. *floridana*. However, we find that endangered species status is not appropriate for these three species. While we have evidence of threats under Factors A and E affecting the species, large populations of these three species are protected and actively managed at ENP and BCNP (*Sideroxylon reclinatum* ssp. *austrofloridense*, ENP (10,000–100,000 plants); *Digitaria pauciflora*, BCNP (>10,000 plants), and ENP (1,000–10,000 plants); and *Chamaesyce deltoidea* ssp. *pinetorum* ENP (10,000–100,000 plants)). Short- and medium-term threats to these three species in these protected areas are being addressed. On the other hand, SLR is projected to have profound negative effects on the habitat of these plants in the foreseeable future. Therefore, based on the best available information, we find that *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* are likely to become endangered species within the foreseeable future throughout all or a significant portion of its range, and we propose to list these species as threatened species in accordance with sections 3(20) and 4(a)(1) of the Act.



### Significant Portion of the Range

Because we have determined that we are proposing to list *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* as threatened species and *Dalea carthagenensis* var. *floridana* as an endangered species throughout all of their ranges, no portion of their ranges can be “significant” for purposes of the definitions of “endangered species” and “threatened species.” See the Service’s SPR Policy (79 FR 37578, July 1, 2014).

### Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness and conservation by Federal, State, Tribal, and local agencies, private organizations, and individuals. The Act encourages cooperation with the States and other countries and calls for recovery actions to be carried out for listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act calls for the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species’ decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed

species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed and preparation of a draft and final recovery plan. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. Revisions of the plan may be done to address continuing or new threats to the species, as new substantive information becomes available. The recovery plan also identifies recovery criteria for review of when a species may be ready for downlisting or delisting, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (composed of species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. If these species are listed, a recovery outline, draft recovery plan, and the final recovery plan will be available on our website (<http://www.fws.gov/endangered>), or from our South Florida Ecological Service Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (e.g., restoration of native vegetation), research, captive-propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and

Tribal lands. If these species are listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost-share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the State of Florida would be eligible for Federal funds to implement management actions that promote the protection or recovery of the four plants. Information on our grant programs that are available to aid species recovery can be found at: <http://www.fws.gov/grants>.

Although *Sideroxylon reclinatum* ssp. *austrorfloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are only proposed for listing under the Act at this time, please let us know if you are interested in participating in recovery efforts for these species. Additionally, we invite you to submit any new information on these plants whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as an endangered or threatened species and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) of the Act requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical

habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into consultation with the Service.

Federal agency actions within these species' habitat that may require conference or consultation or both as described in the preceding paragraph and include management and any other landscape-altering activities on Federal lands administered by the U.S. Fish and Wildlife Service, National Park Service, and Department of Defense; issuance of section 404 Clean Water Act permits by the Army Corps of Engineers; construction and management of gas pipeline and power line rights-of-way by the Federal Energy Regulatory Commission; construction and maintenance of roads or highways by the Federal Highway Administration; and disaster relief efforts conducted by the Federal Emergency Management Agency.

With respect to endangered plants, prohibitions outlined at 50 CFR 17.61 make it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, sell or offer for sale in interstate or foreign commerce, or to remove and reduce to possession any such plant species from areas under Federal jurisdiction. In addition, for endangered plants, the Act prohibits malicious damage or destruction of any such species on any area under Federal jurisdiction, and the removal, cutting, digging up, or damaging or destroying of any such species on any other area in knowing violation of any State law or regulation, or in the course of any violation of a State criminal trespass law. Exceptions to these prohibitions are outlined in 50 CFR 17.62.

With respect to threatened plants, the prohibitions outlined at 50 CFR 17.71 include all of the provisions in 50 CFR 17.61 that apply to endangered plants, with one exception: seeds of cultivated specimens of species treated as threatened shall be exempt from all provisions of 50

CFR 17.61, provided that a statement that the seeds are of “cultivated origin” accompanies the seeds or their container during the course of any activity otherwise subject to these regulations.

Preservation of native flora of Florida (Florida Statutes 581.185) sections (3)(a) and (b) provide limited protection to species listed in the State of Florida Regulated Plant Index including *Sideroxylon reclinatum* ssp. *austrifloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* as described under Factor D, *The Inadequacy of Existing Regulatory Mechanisms*. Federal listing increases protection for these plants by making violations of section 3 of the Florida Statute punishable as a Federal offense under section 9 of the Act. This provision provides increased protection from unauthorized collecting and vandalism for the plants on State and private lands, where they might not otherwise be protected by the Act, and increases the severity of the penalty for unauthorized collection, vandalism, or trade in these plants.

The Service acknowledges that it cannot fully address some of the natural threats facing *Sideroxylon reclinatum* ssp. *austrifloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* (e.g., hurricanes, storm surge) or even some of the other significant, long-term threats (e.g., climatic changes, SLR). However, through listing, we provide protection to the known populations and any new population of these plants that may be discovered (see discussion below). With listing, we can also influence Federal actions that may potentially impact this plant (see discussion below); this protection is especially valuable if these plants are found at additional locations.

We may issue permits to carry out otherwise prohibited activities involving endangered plants under certain circumstances. Regulations governing permits are codified at 50 CFR 17.62 and 17.72. With regard to endangered plants, the Service may issue a permit authorizing any

activity otherwise prohibited by 50 CFR 17.61 and 17.72 for scientific purposes or for enhancing the propagation or survival of endangered plants.

It is our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a proposed listing on proposed and ongoing activities within the range of species proposed for listing. Based on the best available information, the following actions are unlikely to result in a violation of section 9, if these activities are carried out in accordance with existing regulations and permit requirements; this list is not comprehensive:

- (1) Import any such species into, or export any such species from, the United States;
- (2) Remove and reduce to possession any such species from areas under Federal jurisdiction; maliciously damage or destroy any such species on any such area; or remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any law or regulation of any State or in the course of any violation of a State criminal trespass law;
- (3) Deliver, receive, carry, transport, or ship in interstate or foreign commerce, by any means whatsoever and in the course of a commercial activity, any such species;
- (4) Sell or offer for sale in interstate or foreign commerce any such species;
- (5) Introduce any nonnative wildlife or plant species to the State of Florida that competes with or preys upon *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*;

(6) Release any unauthorized biological control agents that attack any life stage of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*; or

(7) Engage in unauthorized manipulation or modification of the habitat of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* on Federal lands.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Field Supervisor of the Service's South Florida Ecological Services Office (see **FOR FURTHER INFORMATION CONTACT**). Requests for copies of regulations regarding listed species and inquiries about prohibitions and permits should be addressed to the U.S. Fish and Wildlife Service, Ecological Services Division, Endangered Species Permits, 1875 Century Boulevard, Atlanta, GA 30345 (Phone 404–679–7140; Fax 404–679–7081).

If *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are listed under the Act, the State of Florida's Endangered Species Act (Florida Statutes 581.185) is automatically invoked, which would also prohibit take of these plants and encourage conservation by State government agencies. Further, the State may enter into agreements with Federal agencies to administer and manage any area required for the conservation, management, enhancement, or protection of endangered species (Florida Statutes 581.185). Funds for these activities could be made available under section 6 of the Act (Cooperation with the States). Thus, the Federal protection afforded to these plants by listing them as threatened or endangered species would be reinforced and supplemented by protection under State law.

Activities that the Service believes could potentially harm these four plants include, but are not limited to:

- (1) Actions that would significantly alter the hydrology or substrate, such as ditching or filling. Such activities may include, but are not limited to, road construction or maintenance, and residential, commercial, or recreational development.
- (2) Actions that would significantly alter vegetation structure or composition, such as clearing vegetation for construction of residences, facilities, trails, and roads.
- (3) Actions that would introduce nonnative species that would significantly alter vegetation structure or composition. Such activities may include, but are not limited to, residential and commercial development, and road construction.
- (4) Application of herbicides, or release of contaminants, in areas where these plants occur. Such activities may include, but are not limited to, natural resource management, management of right of ways, residential and commercial development, and road construction.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Service's South Florida Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

### **Critical Habitat**

Section 3(5)(A) of the Act defines critical habitat as “(i) the specific areas within the geographical area occupied by the species, at the time it is listed...on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the



geographical area occupied by the species at the time it is listed upon a determination by the Secretary that such areas are essential for the conservation of the species. Section 3(3) of the Act defines conservation as to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary.”

Section 4(a)(3) of the Act, as amended, and implementing regulations (50 CFR 424.12), require that, to the maximum extent prudent and determinable, the Secretary will designate critical habitat at the time the species is determined to be an endangered or threatened species. Our regulations (50 CFR 424.12(a)(1)) state that the designation of critical habitat is not prudent when one or both of the following situations exist:

(1) The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species, or

(2) Such designation of critical habitat would not be beneficial to the species.

There is currently no imminent threat of take attributed to collection or vandalism under Factor B for these species, and identification and mapping of critical habitat is not expected to initiate any such threat. Therefore, in the absence of finding that the designation of critical habitat would increase threats to a species, if there are any benefits to a critical habitat designation, a finding that designation is prudent is warranted. Here, the potential benefits of designation include: (1) triggering consultation under section 7 of the Act, in new areas for actions in which there may be a Federal nexus where it would not otherwise occur because, for example, it is unoccupied; (2) focusing conservation activities on the most essential features and areas; (3) providing educational benefits to State or county governments or private entities; and (4) preventing people from causing inadvertent harm to these species.

Because we have determined that the designation of critical habitat will not likely increase the degree of threat to the species and may provide some measure of benefit, we determine that designation of critical habitat is prudent for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*.

Our regulations (50 CFR 424.12(a)(2)) further state that critical habitat is not determinable when one or both of the following situations exists: (1) information sufficient to perform required analysis of the impacts of the designation is lacking; or (2) the biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat. On the basis of a review of available information, we find that critical habitat for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* is not determinable because the specific information sufficient to perform the required analysis of the impacts of the designation is currently lacking.

## **Required Determinations**

### *Clarity of the Rule*

We are required by Executive Orders 12866 and 12988 and by the Presidential Memorandum of June 1, 1998, to write all rules in plain language. This means that each rule we publish must:

- (1) Be logically organized;
- (2) Use the active voice to address readers directly;
- (3) Use clear language rather than jargon;

- (4) Be divided into short sections and sentences; and
- (5) Use lists and tables wherever possible.

If you feel that we have not met these requirements, send us comments by one of the methods listed in **ADDRESSES**. To better help us revise the proposed rule, your comments should be as specific as possible. For example, you should tell us the numbers of the sections or paragraphs that are unclearly written, which sections or sentences are too long, the sections where you feel lists or tables would be useful, etc.

*National Environmental Policy Act (42 U.S.C. 4321 et seq.)*

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act, need not be prepared in connection with listing a species as an endangered or threatened species under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

*Government-to-Government Relationship with Tribes*

No Native American tribes are affected by the proposed rule.

## **References Cited**

A complete list of references cited in this rulemaking is available on the Internet at <http://www.regulations.gov> at Docket No. FWS–R4–ES–2016–0090 and upon request from the South Florida Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

## Authors

The primary authors of this proposed rule are the staff members of the South Florida Ecological Services Field Office.

## List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

## Proposed Regulation Promulgation

Accordingly, we propose to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

### PART 17—ENDANGERED AND THREATENED WILDLIFE AND PLANTS

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; 4201–4245; unless otherwise noted.

2. In § 17.12(h) add entries for “*Chamaesyce deltoidea* ssp. *pinetorum*”, “*Dalea carthagenensis* var. *floridana*”, “*Digitaria pauciflora*”, and “*Sideroxylon reclinatum* ssp. *austrofloridense*” to the List of Endangered and Threatened Plants in alphabetical order under Flowering Plants to read as set forth below:

#### § 17.12 Endangered and threatened plants.

\* \* \* \* \*

(h) \* \* \*

Scientific name	Common name	Where listed	Status	Listing citations and applicable rules
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FLOWERING PLANTS				
* * * * *				
<i>Chamaesyce deltoidea</i> ssp. <i>pinetorum</i>	Pineland sandmat	Wherever found	T	<b><u>[Federal Register citation of the final rule]</u></b>
* * * * *				
<i>Dalea carthagenensis</i> var. <i>floridana</i>	Florida prairie-clover	Wherever found	E	<b><u>[Federal Register citation of the final rule]</u></b>
* * * * *				
<i>Digitaria pauciflora</i>	Florida pineland crabgrass	Wherever found	T	<b><u>[Federal Register citation of the final rule]</u></b>
* * * * *				
<i>Sideroxylon reclinatum</i> ssp. <i>austrofloridense</i>	Everglades bully	Wherever found	T	<b><u>[Federal Register citation of the final rule]</u></b>
* * * * *				

Dated: September 29, 2016.

Stephen Guertin

*Acting Director, U.S. Fish and Wildlife Service.*

Billing Code 4333–15

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